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PIPE LINE INDUSTRY

SPECIAL API PIPE LINE REPORT

LOOKING AHEAD

What's New for Crude and Products Lines 47

PORT PIPE LINES

How to Design Offshore Tanker Moorings 56

BETTER MANAGEMENT

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TRUNKLINE REPORTS

How Sandblasting Boosts Gas Flow 40

FOR THE FIRING LINE

Another Automatic Welding Machine Here 46

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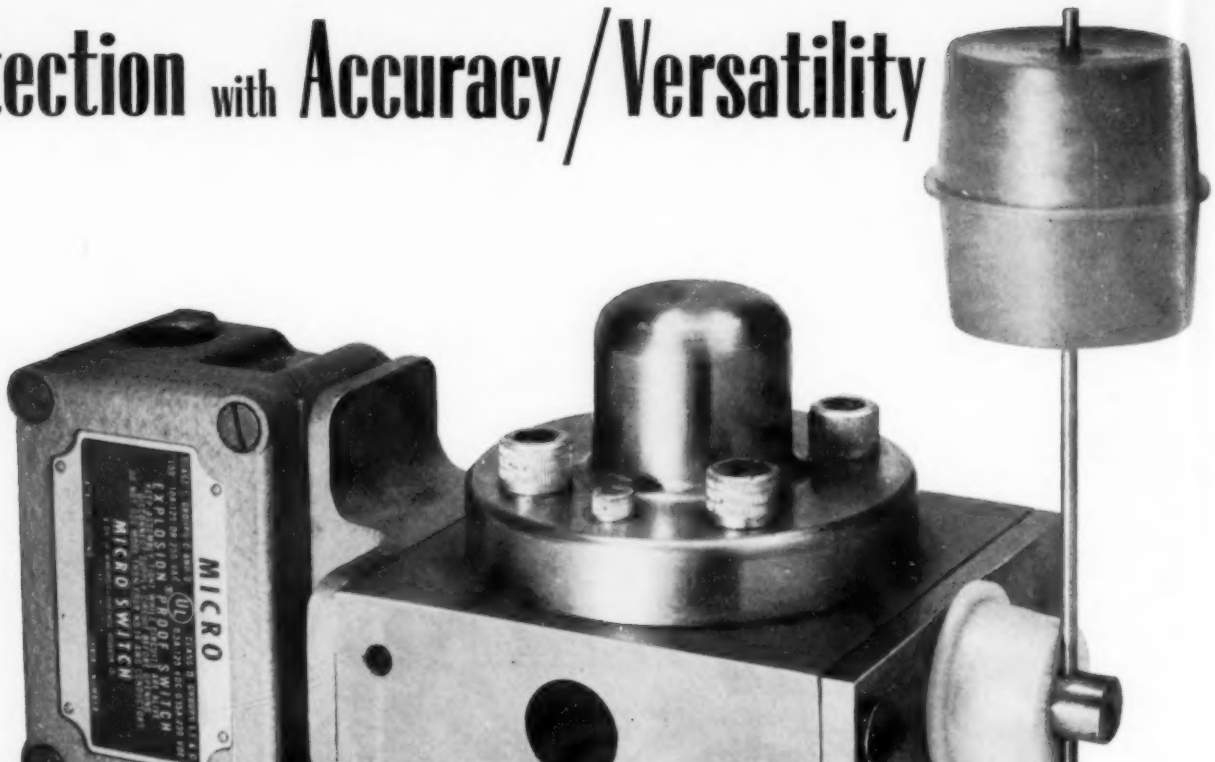
Detection with Accuracy/Versatility



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PIPE LINE INDUSTRY

A GULF PUBLISHING COMPANY PUBLICATION

May 1961 Vol. 14, No. 5

CONTENTS and Quick Look

To help you put first things first, scan these time-saving digests, checking ☑ those you want to read first.

Trunkline Reports on Low-Cost Sandblasting That Increases Gas Flow—Part 1.

☐ By blowing sharp sand through a pipe line using natural gas as motive power, the interior of the pipe can be cleaned, smoothed and polished. The result is an appreciable increase in "E" factors. This technique, developed by Trunkline Gas Company engineers, probably provides the most efficient, practical way to increase capacity on many gas transmission systems. In this first of two parts, the authors describe preliminary work in this field and the means used to extrapolate to estimate its effect on large diameter pipe.

By Adrian W. McAnneny and Lester C. Sullivan Page 40

Another New Automatic Welding Machine for the Firing Line

☐ This one differs from the one described in the March issue of PIPE LINE INDUSTRY. It is a lightweight piece of equipment, pushbutton controlled by an operator who can see the weld at all times. Pipe end preparation is the same as that used for conventional manual welding and the line-up gap is standard. The machine makes two passes from top to bottom to complete a weld. Time on 36-inch, 7/16-inch wall pipe: 8 minutes! ..... Page 46

How Secretary Udall Views Issues Affecting the Pipe Line Industry

☐ There is little doubt that Interior Secretary Udall will take an increasing role in petroleum affairs—one far greater than any of his immediate predecessors. For an exclusive report on plans to increase his "leadership function," turn to PIPE LINE INDUSTRY interview on ..... Page 69

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API PIPE LINE REPORT

New Developments in Crude and Products Pipe Line Operations

☐ Statistics show the pipe line industry is entering a period of accelerating evolution. This is especially true in the technical fields. Here are five such innovations which the author discusses: 1. Remotely controlled tank switching. 2. Hydraulic signal pressure control. 3. Alternate pressure telemetering. 4. The development of an area station maintainer, and 5. Automatic welding for pipe lines.

By Fred S. Jones ..... Page 47

Manning for Tomorrow's Operations Today

☐ Many may regard today's trends in the oil industry as discouraging, but, actually, they are bringing us our most exciting challenges yet. Never before has it been so urgent that men in management THINK and PLAN! Never before have there been so many opportunities for the *thinking* pipeliner.

By Jack A. Horner ..... Page 52

Designing and Using Offshore Tanker Moorings

☐ Here's a subject of increasing interest to crude and products pipeliners. The fine points of design of such installations can tie in closely to the economics of an entire pipe line project.

By Robert P. Howell ..... Page 56

How to Make Pipe Line Management More Effective

☐ It can be done through organization, and here is an organizational plan which can keep systems competitive and profitable. Summarized, a pipe line company should be organized with definite goals and objectives. It should have a plan for attaining these objectives and a method of continual evaluation.

By A. J. Helmbrecht ..... Page 63

Underground Storage Operations for LPG

☐ What are the operating problems of underground storage caverns? What does it take to maintain them? How are the problems being solved by the industry? Here is a discussion of these questions which are based on reports from over 50 companies with underground storage facilities.

By G. P. Jennings ..... Page 66

PIPE LINE INDUSTRY published every month. Second class postage paid at Houston, Texas. © Gulf Publishing Company 1961

Needed: More Interchange of Ideas

ALWAYS, DURING PERIODS of tight profit margins, the need for continuing widespread interchange of engineering operating ideas has been emphasized in the petroleum industry. At the same time, it also is true that an industry looks for ways to pare its budget during interims when return on capital investment leaves much to be desired. And frequently, some companies tend to reduce budgets by cutting down on the number of meetings their technical personnel attend.

However, reduced attendance at technical meetings, while satisfying a budget-reduction effort, may work as a disadvantage unless the interchange of technical ideas and progress continues through other means.

Recognizing the need for providing—in a single publication—adequate coverage of the technical papers presented at the API Pipe Line Conference, PIPE LINE INDUSTRY has published its special API reports for several years.

And two gratifying developments have occurred immediately.

1. Many company representatives said the issue fulfilled the need for supplying a permanent record of technical papers presented at the meetings for their *personnel who did not attend the API sessions.*

2. A large number of those *who attended* the meetings expressed their interest in having an easily-accessible record of the technical papers in one issue—a record that many have told us has been referred to innumerable times during the past years.

It is for these reasons that PIPE LINE INDUSTRY, in this issue again is presenting a summary of API technical papers . . . in an effort to help in the interchange of technical data required and desired by technical personnel who attend these meetings as well as those who do not.

Let's Stop Leaning on Uncle Sam

How BIG can we allow Federal Government to get?

Uncle Sam now owns or controls about 20 percent of our industrial capacity. Regulation and control have almost reached the strangulation stage. Federal annual budgeted expenditure has risen from $3 billion in 1932 to $77 billion in 1960. About 30 percent of all we earn goes to Federal coffers.

Our gross national product expanded from $100 billion to $500 billion between 1940 and 1960. While GNP was expanding *five times,* Federal spending increased *eight times*—Federal debt increased *seven times.*

Talk now of making Federal Power Commission and other agencies bigger. Oil and Gas Administrator Lawrence O'Connor gave the impression in St. Louis recently that if states don't do something about prorating natural gas liquids production Uncle Sam will. Should end use controls result from Fuels Policy Study, a new corps of Government personnel will be needed to decide what fuels consumers can use.

And these concern one industry among many. What can be done about it?

1. We must stop asking for or permitting government at any level to do for us what we can and should do for ourselves.

2. Excessive government power must be taken from Washington and returned to state capitols, county seats and city halls.

3. We must make our voices heard where it counts.

Men grow in dignity, self respect and leadership by assumption and discharge of responsibility. Our responsibility is to restore and preserve the freedoms, including free enterprise, guaranteed us by the Constitution of the United States.

A 60-INCH VIEW OF CAT'S POWER SHIFT 583 PIPELAYERS

Report from Jack Hodges, General Supt., J. P. Neill & Company, Inc., Birmingham, Alabama

"The power shift on the new Cat 583 allows split-second shifts when juggling 60″ pipe. The operator can handle the draw works levers and change travel speeds by nudging the *single* transmission lever with his forearm—impossible otherwise. When climbing these grades, he can smoothly drop to a lower gear to keep the load moving. Machines with other type transmissions must stop and slow down the operation."

Jack Hodges is talking about performance from the two 583s working on the industrial water line from Fort Smith Dam to Birmingham, Ala. They're handling 60″ pipe, weighing 20,000 lb. per 40′ joint, over rough terrain with grades up to 67½ degrees. "It's the kind of job that brings out the best and shows up the worst in any machine. That's why the 583s look so good."

The beautifully engineered combination of 235 HP, 137,000 LB. LIFT CAPACITY, POWER SHIFT TRANSMISSION, and an unmatched 21″ GROUND CLEARANCE equip the 583 for heavy work in mountains or swamps . . . work that other machines can't handle over ground where other machines can't go. No wonder men who work with the 583 talk long and favorably about it.

For your own record-setting production *with low cost* . . . see your Caterpillar Dealer.

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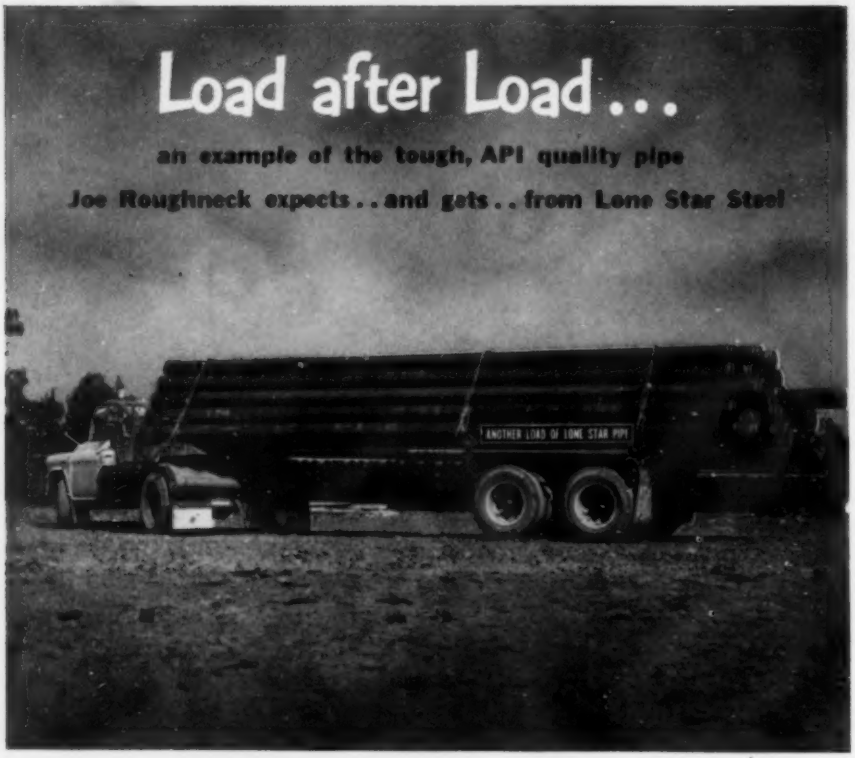
HEAVY-DUTY PIPELAYERS FOR THE HARD WORK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an example of the tough, API quality pipe
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PETROLEUM REFINER and the REFINERY CATALOG for the Hydrocarbon Processing Industry.

Indexed by Engineering Index

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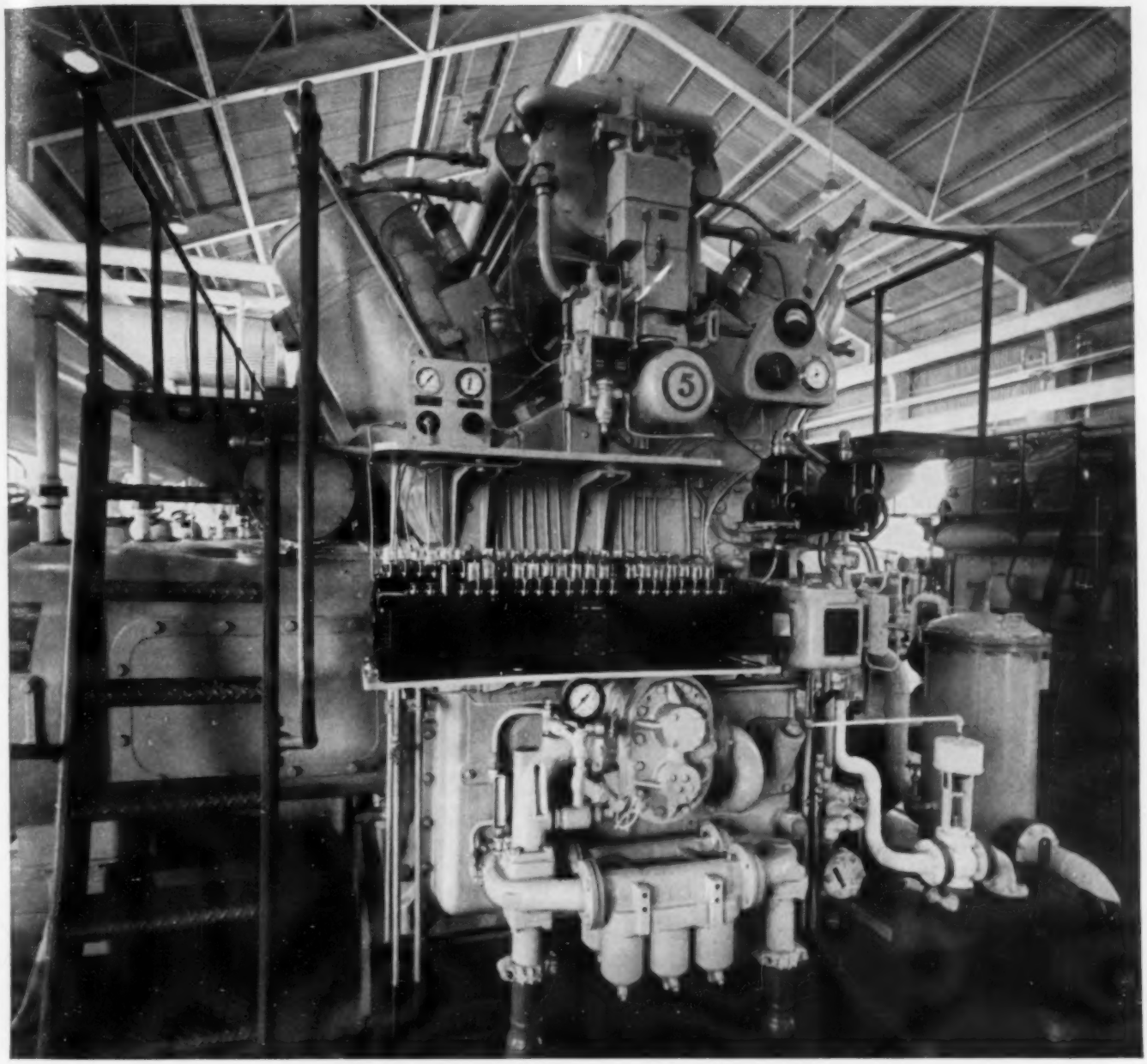

BENDIX MAGNETOS SPARK COOPER-BESSEMER ENGINES FOR EL PASO NATURAL GAS

Once again, Bendix* ignition equipment is proving its worth to the petroleum and natural gas industries. Shown here is a Bendix LAR magneto and Hi-V transformer coil installation at El Paso Natural Gas Company's Blanco Station in San Juan County, New Mexico. El Paso uses eight 1350 hp. Cooper-Bessemer gas compressors, all equipped with Bendix magnetos, at its mainline gas booster station.

Bendix LAR magnetos deliver dependable ignition at the lowest practicable cost. Even under the most adverse operating conditions, their reserve power ensures smooth engine performance. The Bendix LAR magneto and Hi-V transformer coil form a matched ignition system to handle rugged engine requirements.

LA magnetos now in service can easily be converted to the modern Bendix LAR type with conversion kits now available. They can be obtained from your Bendix ignition distributor or from the factory. For complete details, write SCINTILLA DIVISION OF THE BENDIX CORPORATION, Sidney, New York.

*REG. TRADEMARK

Scintilla Division
SIDNEY, N. Y

THE Bendix CORPORATION

For more data on advertised products, use Readers' Service Cards, last page.

BANTAM'S big-rig features do more... earn more

Here's the most modern crawler mounted crane-excavator ever built—the BANTAM C-350! For capacity, performance and profit-making versatility, BANTAM has all the big-rig features that you want: the fastest work cycles, widest work range, biggest choice of equipment.

The ideal high-production pipeliners' crawler rig, BANTAM C-350 has standard 2-speed, independent travel permitting you to lift, swing and travel all at the same time. On big or small jobs, BANTAM with back hoe digs over 100′ of 5′ trench per hour. Add the optional BANTAM long-boom back hoe, and you dig to 18′10″ without "digging in" first to get that extra depth.

Crawler BANTAM goes everywhere!

BANTAM's low ground-bearing pressure (less than 3 lbs. per sq. inch with 32″ pads) and resulting high flotation let you go over *any* terrain without bogging down. And BANTAM's fast-acting, easy-operating mechanical controls are never affected by freezing, heat or moisture—completely maintenance-free.

BANTAM's advanced, rugged design outdates all others and assures you of years of trouble-free service on all kinds of jobs. It's travel-ready at all times—with no disassembly or special permits needed. You save time coming and going, as well as on the job.

Work and earn with 11 BANTAM-built attachments

BANTAM handles all your excavating and lifting chores, working with 11 fast-change attachments. In addition, more than 25 optional features let you equip your BANTAM to match your specific needs.

◀ Another popular BANTAM for pipeline operations—the carrier mounted BANTAM T-350. Husky 11-ton lifting capacity and easy, permit-free mobility make this BANTAM the mobile work leader of its size. Works and earns with all BANTAM-built attachments. Check the self-propelled BANTAM CR-350, too—one-man, one-engine operation. 4 x 4 drive optional.

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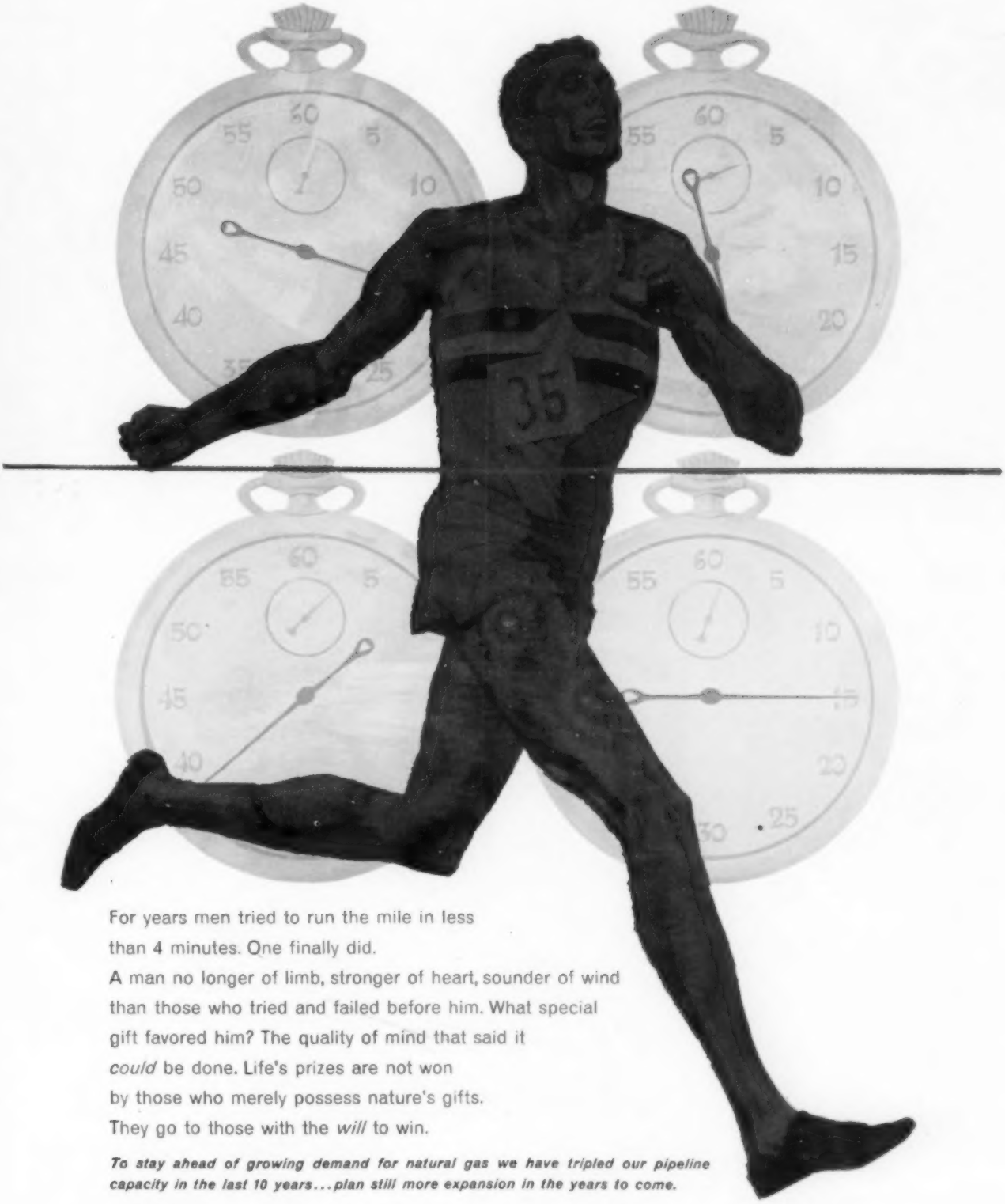
THE FOUR MINUTE MIND



For years men tried to run the mile in less than 4 minutes. One finally did.
A man no longer of limb, stronger of heart, sounder of wind than those who tried and failed before him. What special gift favored him? The quality of mind that said it *could* be done. Life's prizes are not won by those who merely possess nature's gifts. They go to those with the *will* to win.

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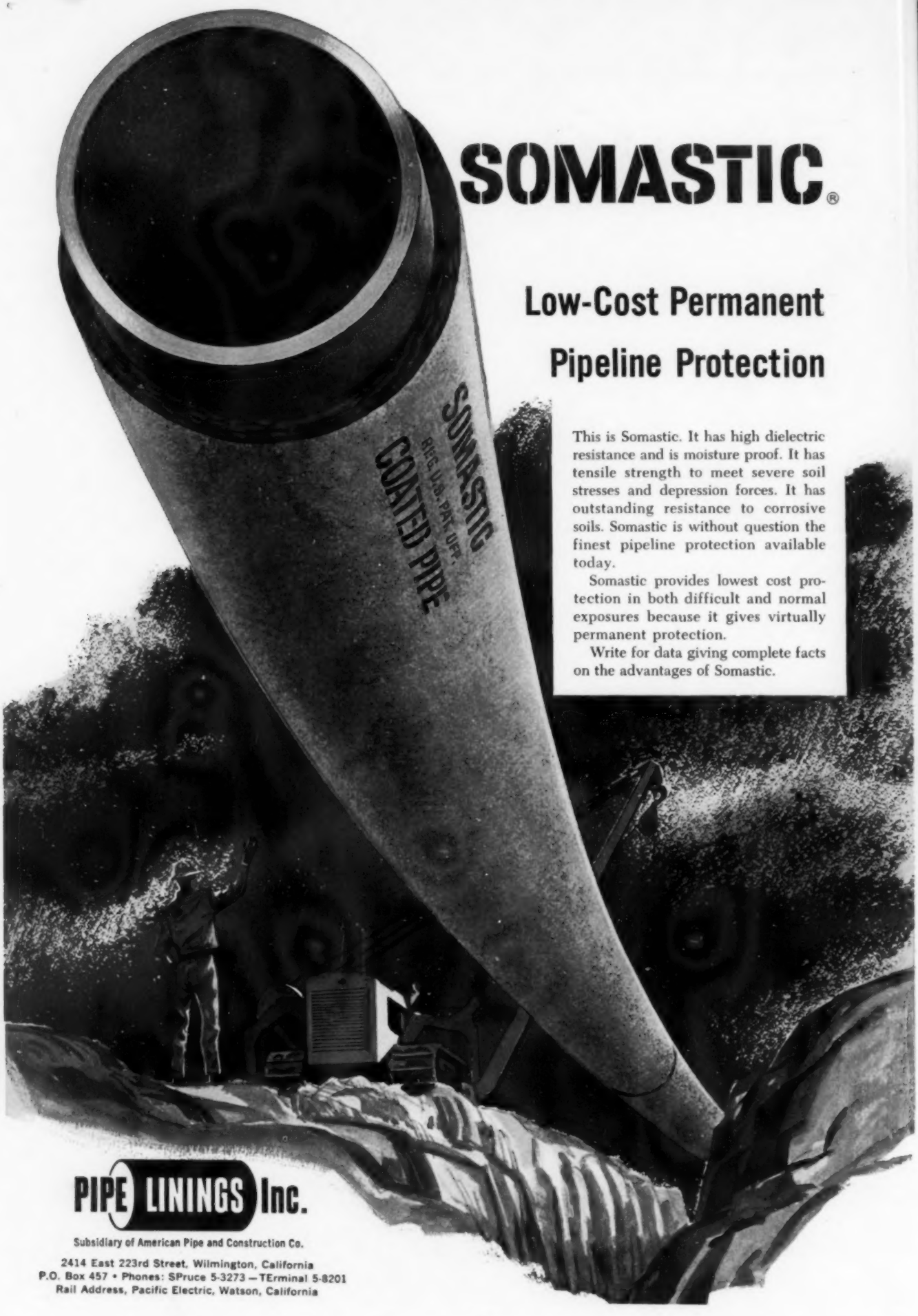

This is Somastic. It has high dielectric resistance and is moisture proof. It has tensile strength to meet severe soil stresses and depression forces. It has outstanding resistance to corrosive soils. Somastic is without question the finest pipeline protection available today.

Somastic provides lowest cost protection in both difficult and normal exposures because it gives virtually permanent protection.

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W. M. May, Freeburg Station Superintendent, and K. W. Robertson, Gas Engineer of Illinois Power, discuss recent expansion of Freeburg Station. Its four 700hp Cooper-Bessemer FM Compressors pump 36,000 mcf/day at 65 psi suction and 260 psi discharge.

Illinois Power reports...

How to keep pressure up when demand goes up

To meet growing gas demands and maintain pressures, Illinois Power Company is expanding its underground storage and its compression facilities. It is now building a new storage station and has just completed additions to two compressor stations.

The Illinois Power system will then comprise one booster station and three storage stations. All are equipped with Cooper-Bessemer FM Compressors... the first units purchased in 1957 and the latest to be installed this year. Two stations are automated and remotely controlled with Cooper-Bessemer En-Tronic systems. Three of the stations were engineered and built by Stearns-Roger Manufacturing Co.

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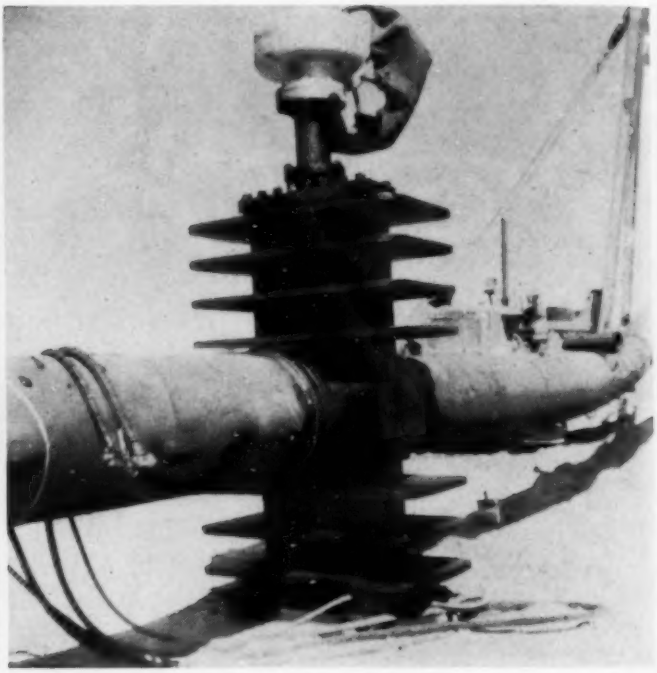
EL PASO NATURAL GAS COMPANY PROTECTS LINE VALVES WITH ROSKOTE COLD-APPLIED MASTIC

Roskote cold-applied mastic was spray-applied to 30" valves by El Paso Natural's personnel at Grants, New Mexico. Risers and support legs were coated with Roskote and wrapped with Royston Glas-Wrap for additional mechanical abrasion protection.



On the El Paso Natural Gas Company line being laid at Fort Stockton, Texas, by Western Pipeline Company, all 20" valves were spray-coated with Roskote cold-applied mastic.

You get superior protection against the most severe field corrosive agents with Roskote cold-applied mastic. Valves, risers, line pipe, tanks and other structures above or below ground are coated with Roskote by spray or brush without heat, flame or toxic and irritating effect on workers. The quick-drying feature of these mastics permits early backfilling. Roskote's time-saving, cost-saving application complements its low first cost to provide you with the most economical means of long-life metal protection.

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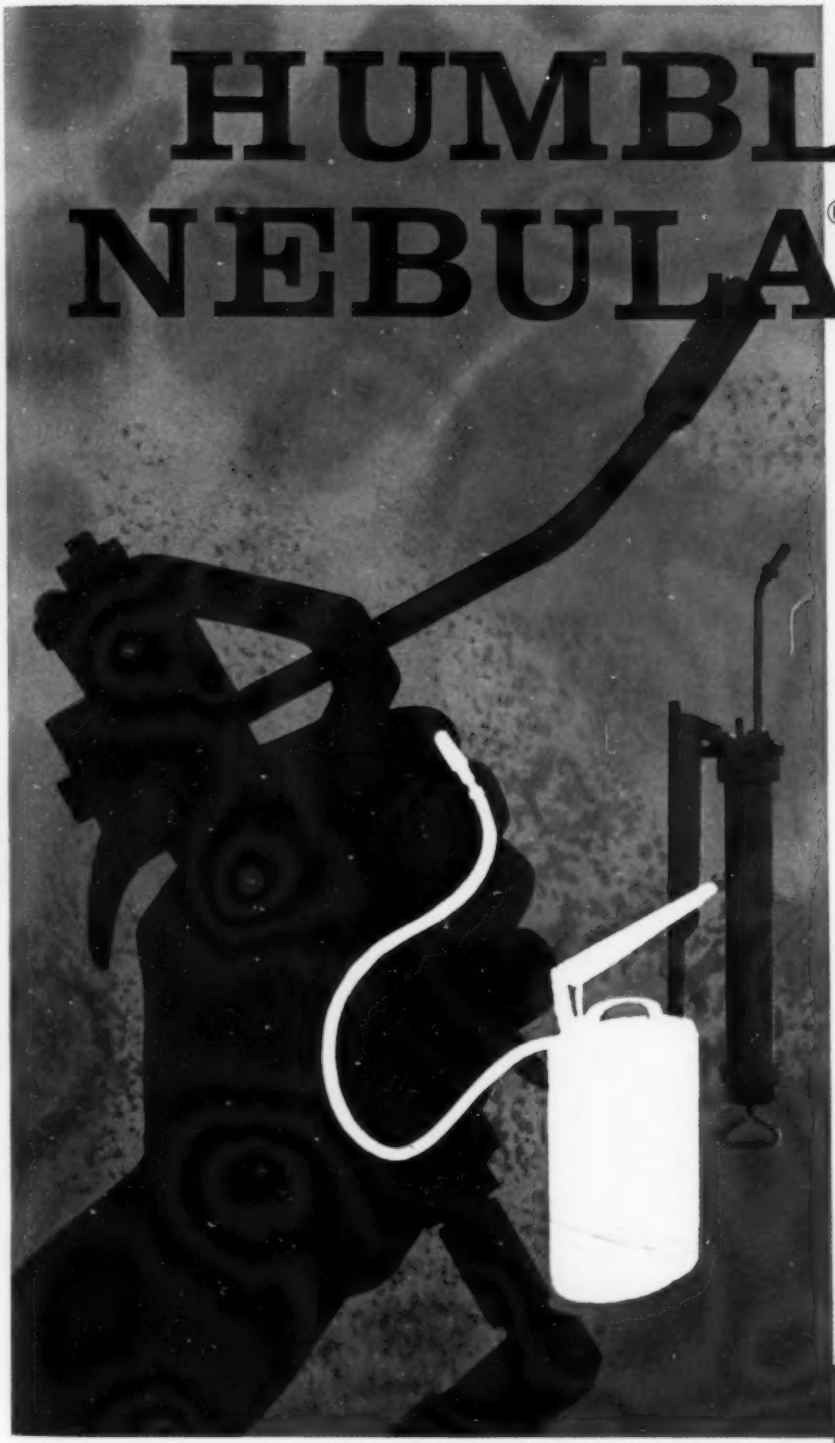

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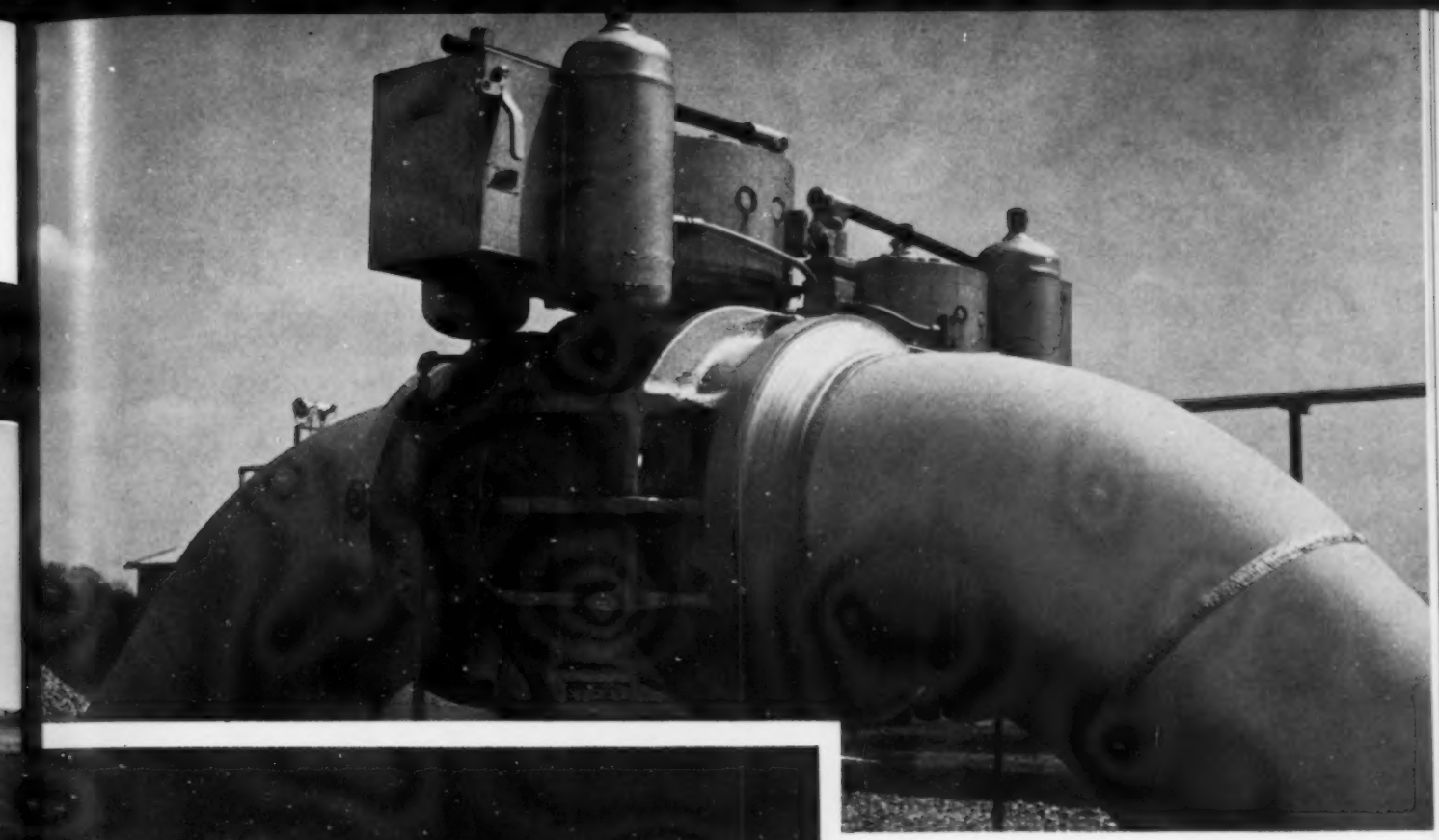
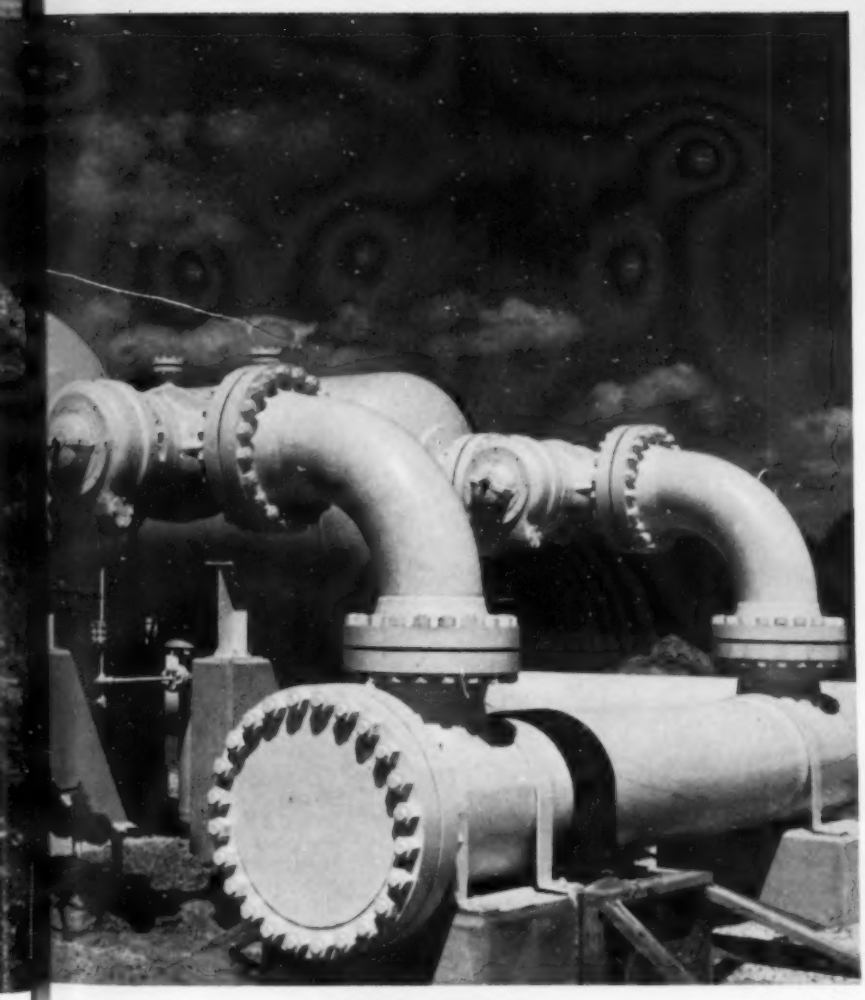
J&L For Better Pipelines!

This is J&L line pipe, ductile, uniformly round, and easy to weld. It is available in 60 foot lengths. J&L quality control during manufacture includes ultrasonic inspections, hydrostatic tests, visual examinations, crush tests of samples from every length and magnaflux examination of both ends of every joint. J&L line pipe has earned its position of prestige with pipeliners.





Men who plan and lay pipelines with J&L line pipe also prefer famous names in valves and fittings. Rockwell-Nordstrom, OIC, W-K-M, Stockham, Taylor Forge . . . all products in the "best available" class. Taylor Forge WeldElls and flanges and Rockwell-Nordstrom lubricated plug valves are featured "on location" here.

For technical information on line pipe, valves and fittings, ask your local J&L Supply man or write us at Tulsa—Drawer 2481. J&L electricweld line pipe is available in sizes from 6⅝" through 12¾" O.D.; J&L seamless line pipe from 2⅜" through 14" O.D.

Jones & Laughlin

SUPPLY DIVISION—Tulsa

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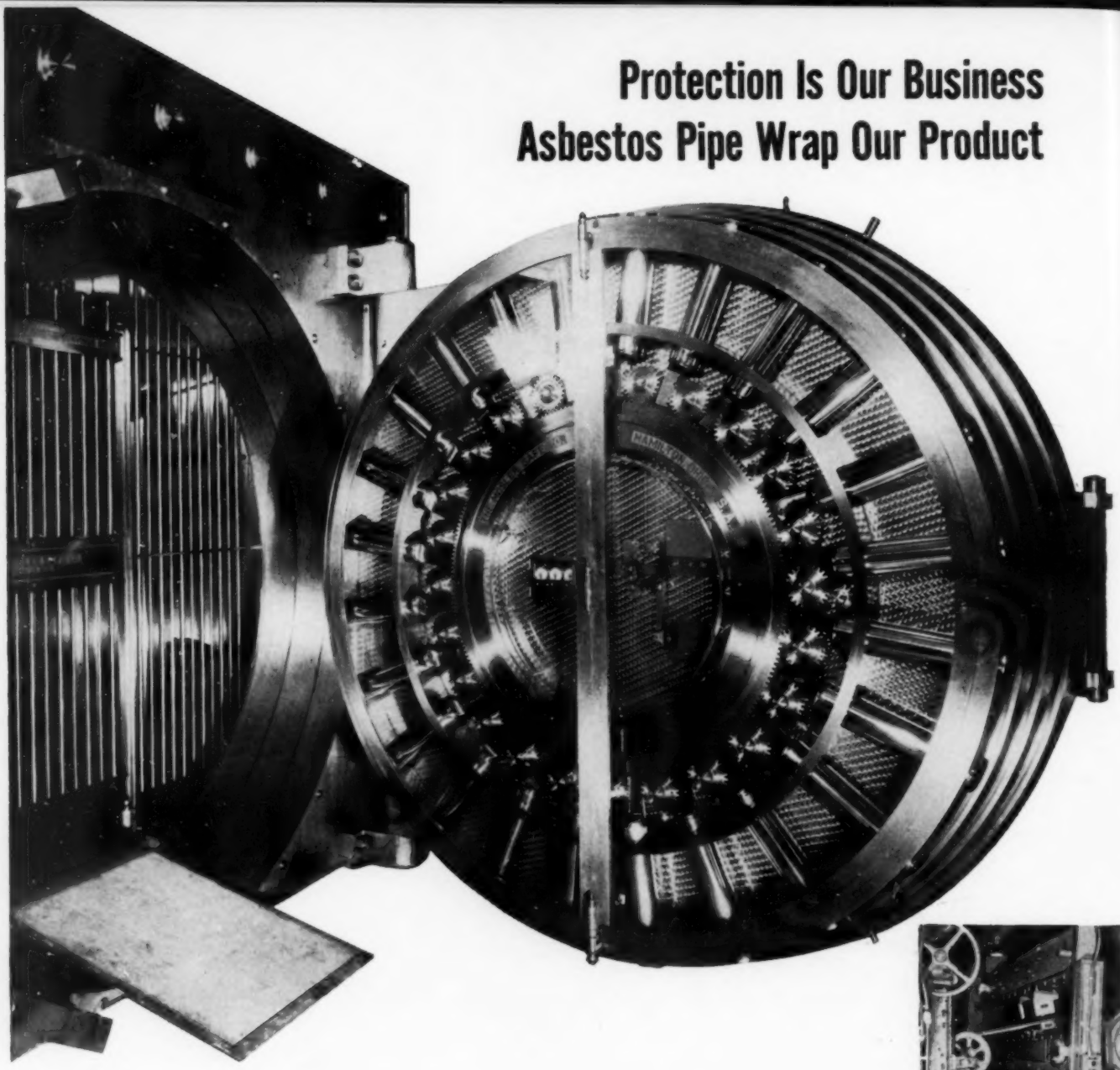
Asbestos Pipe Wrap Our Product



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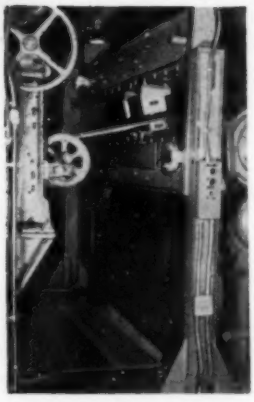

Protection starts with Quality Control. At Nicolet, this Curtiss-Wright Basis Weight Measuring System measures and records pipe wrap weight without contact at the wet end . . . assuring continuous conformity throughout.

Distributed throughout the United States

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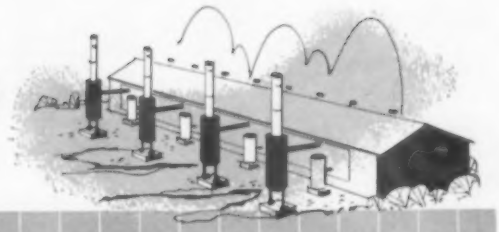
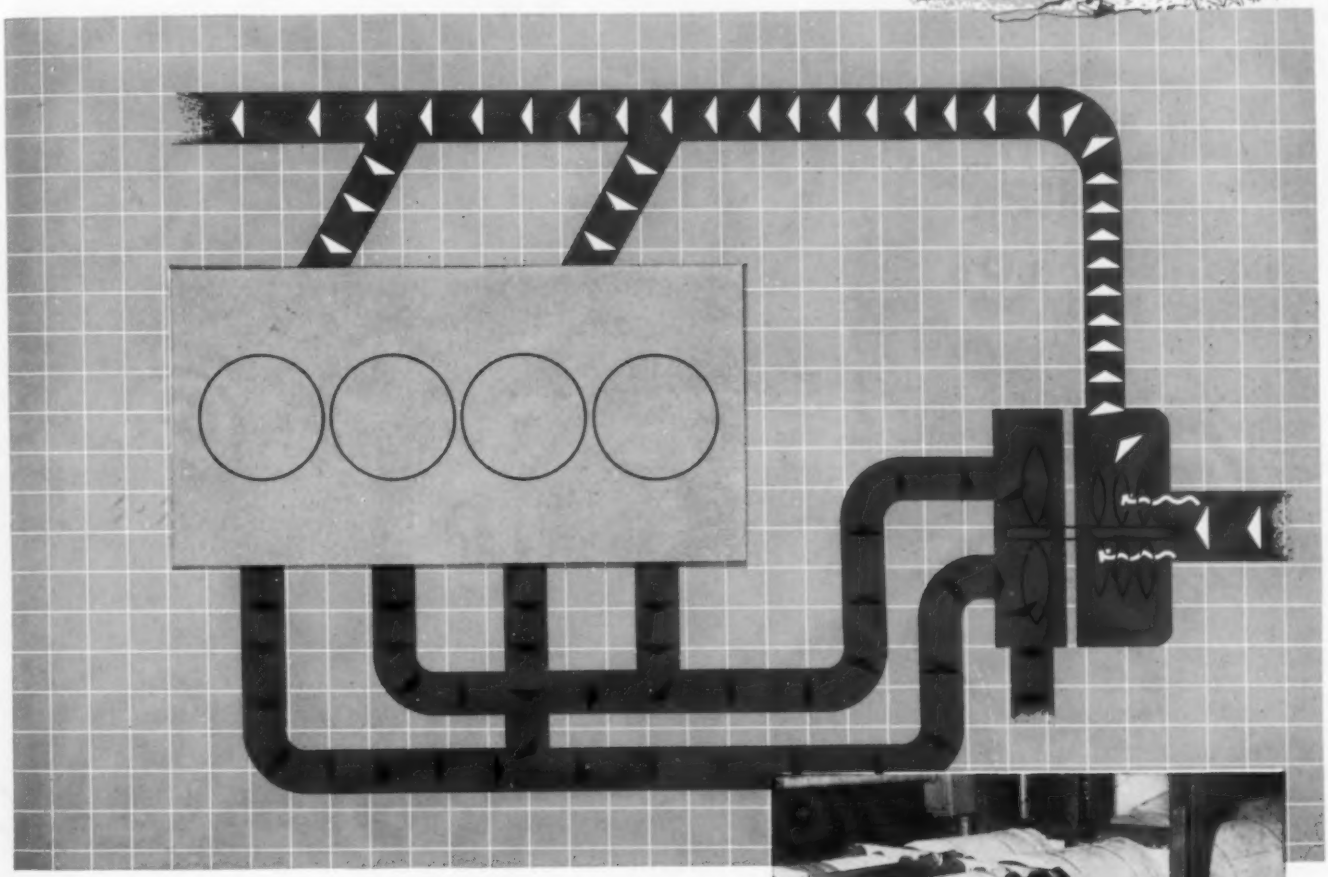
FLORHAM PARK, NEW JERSEY

Flexonics

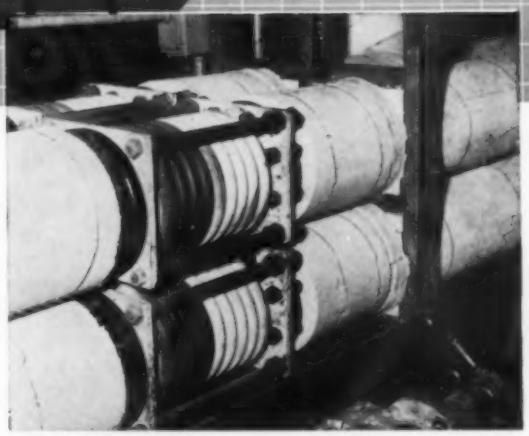
has the engineering experience to help you solve exhaust expansion problems when you turbocharge compressors





Here's a lively subject – *increasing gas pipeline capacity by turbocharging existing compressors in the field.* If you want the answers to the expansion problems that arise when the exhaust piping becomes an integral part of the operating loop, call on FLEXONICS engineers. They have the *specific* experience in this field that can mean actual dollar savings to you.

Write today for your free copy of this easy-to-read report. It tells you the dollars-and-cents facts that led an important pipeline company to a complete turbocharging program.



Special-design FLEXONICS Expansion Joints in the exhaust piping of a newly turbocharged compressor station.

EJ-250

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BELLOWS • SPECIAL TUBULAR ASSEMBLIES

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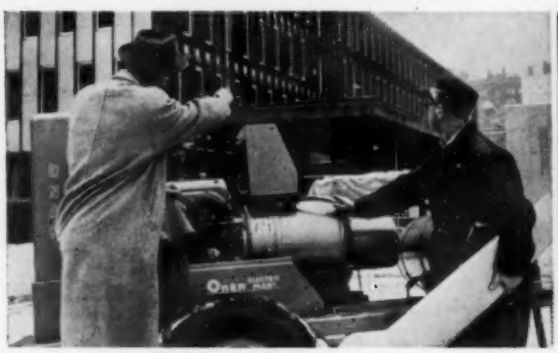

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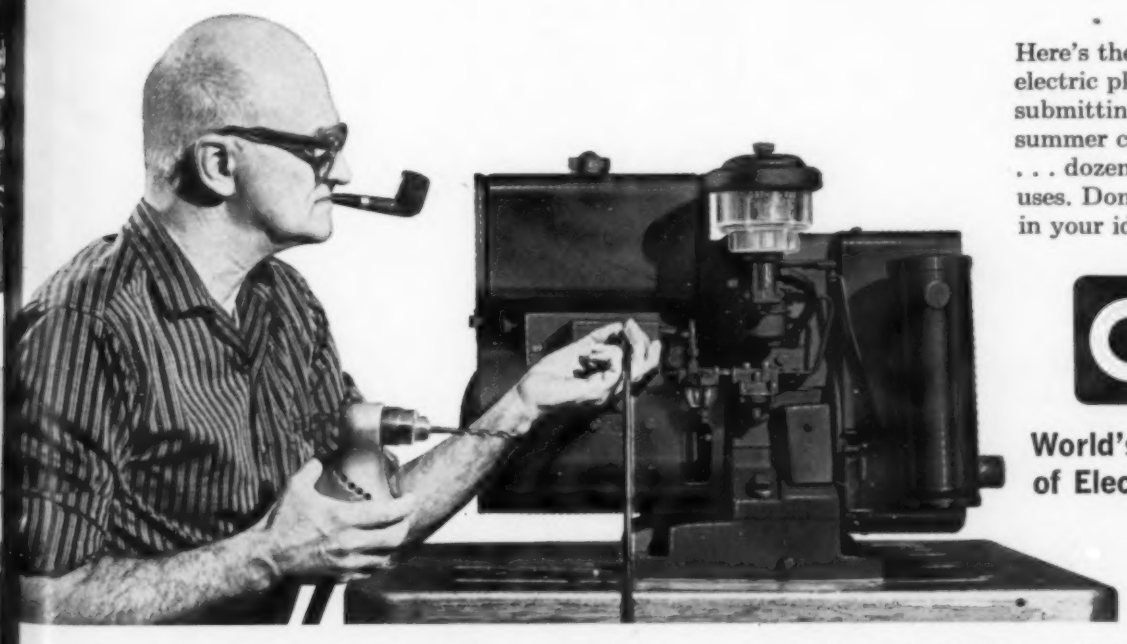
*You may submit as many ideas as you wish, but no more than one Onan plant will be awarded to an individual. There are no restrictions on form of entry . . . you may submit photographs, sketches or a written statement of any length you desire. Onan will judge all entries on the basis of originality, practicality and commercial utility, and decisions of the judges will be final. If the same suggestion or similar suggestions are made by more than one entrant, the first one submitted, according to the postmark, will be eligible for the prize. Winners will be notified on or before July 15, 1961. Entries must be mailed to "New Uses Contest," address below, and must be received not later than June 15, 1961. All ideas submitted become the property of Onan and, whether or not the entries receive an award, may be used commercially by Onan in any way it sees fit with or without acknowledgment of the originator. No entries can be returned.



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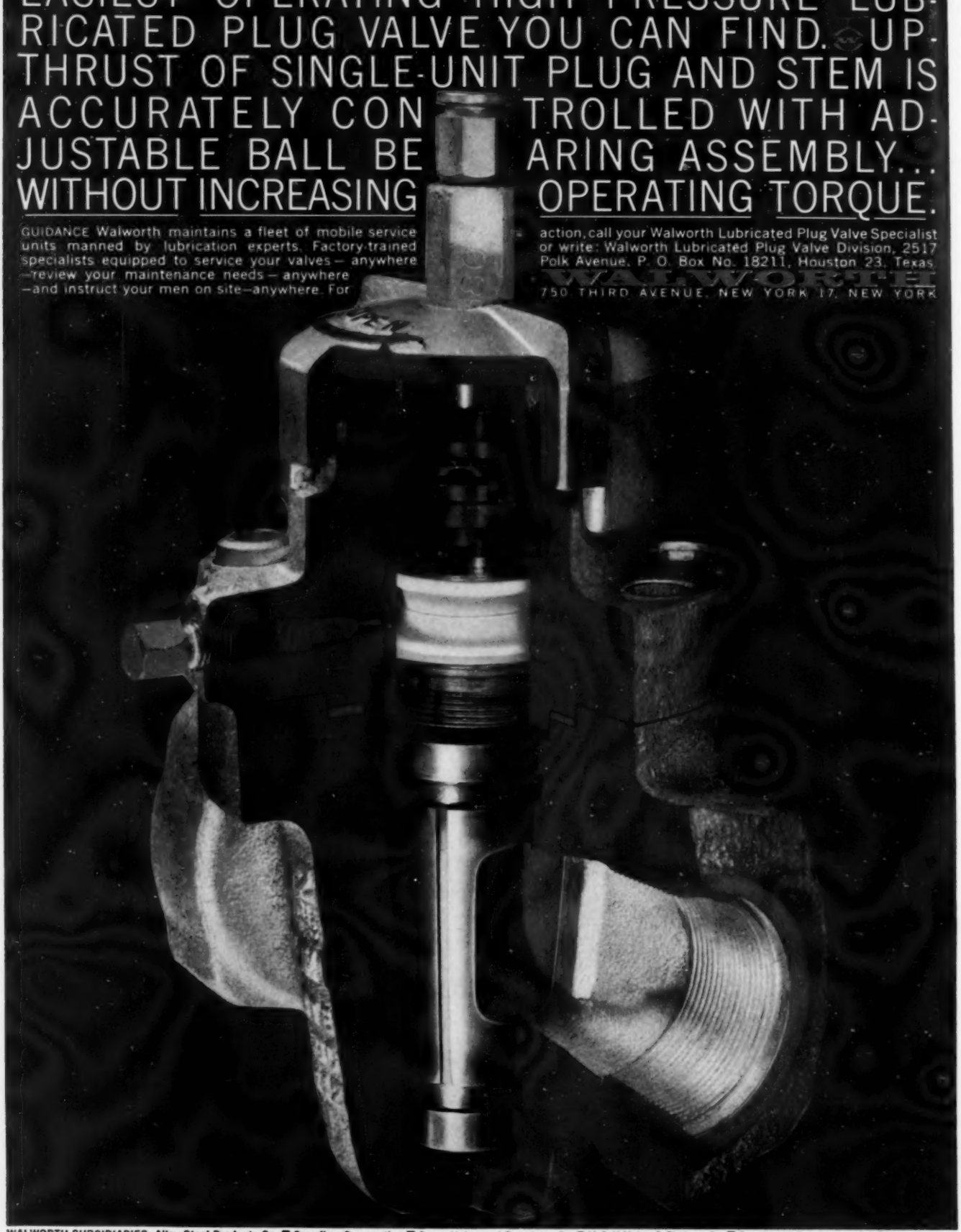

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—for Sharman, Allen, Gay & Taylor,

Two International Paywelder units keep eight welders busy making stringer bead and hot-pass welds on a Sharman, Allen, Gay & Taylor, Inc., gas line-looping contract in Mississippi. The welding gang averages 150 joints, a full mile, per 10-hour day. This contractor gets the same efficiency from a second Paywelder team on another spread.

"The TD-15 Paywelder has proven to be the best welding rig of its type, by far, in my experience," states Pipe Gang Foreman B. L. Northam. "I've had them on really rough right-of-way—and flotation and balance are excellent. Plenty of Paywelder power means continuous output for fast, even welding, with efficient speed."

Factory engineered and all factory built, the high-output, 325-amp Paywelder is powered and carried by the 6-cylinder International TD-15 crawler tractor—equipped to produce 120 intermittent hp. Unit consists of two Lincoln dual welders with four welding leads—and is V-belt driven from the front pto.

You can mount your clamp-actuating air compressor on the strong front extension platform—and drive it from front power take-off extension, that's standard Paywelder equipment. Carry extra pipe clamp and supplies on large rear platform (also standard equipment).

You can "shoe" this 74-inch-gauge unit with 24-inch tracks—to hug hillsides, tread surely over bogs. Thorough sealing of vital parts excludes trouble-making grit and moisture.

Team "sparks" line joints per day

Inc., Houston, Texas

Spot a Paywelder on your spread and compare! Measure the economies of combining four welders and compressor in a one-man operated, pipeliner-proven, big-capacity rig. Let your International Construction Equipment Distributor demonstrate on your spread.

International TD-15 Paywelder, equipped to produce 120 intermittent hp, easily delivers current needed for four welding leads—and has reserve power to drive the 3½ x 2½ Quincy compressor from front pto, to operate a CRC pipe clamp.

Each of these two International TD-15 Paywelder units powers four 325-amp. welding leads. The front Paywelder carries and powers (from pto) a front platform-mounted clamp actuating compressor. And the rear Paywelder tows a sled-mounted unit equipped with two 200-amp. welding leads. Contractor is looping a 36-inch gas line between Seminary and Soso, Mississippi—for Transcontinental Pipeline Corp.

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NATURAL GAS lines at compressor and meter stations give years of maintenance-free service when protected by TAPECOAT, the coal tar coating in handy tape form.

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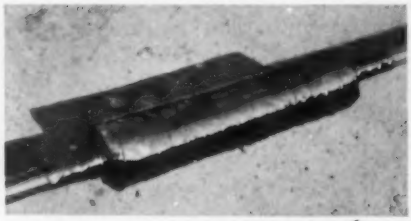
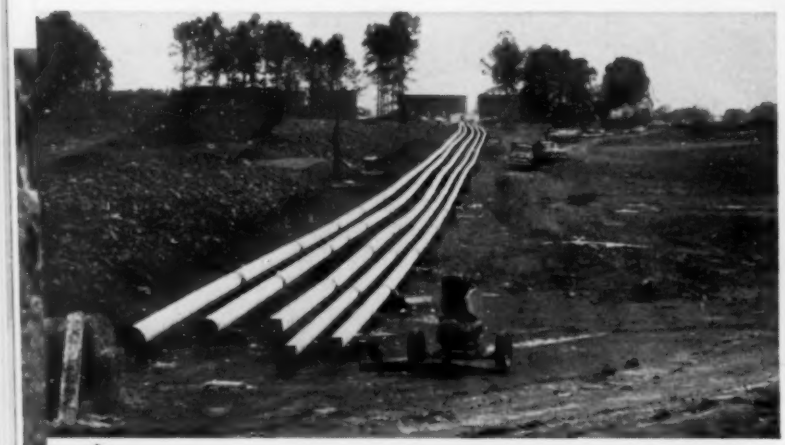


CABLE AND CABLE SPLICES in communications service are effectively and economically protected by TAPECOAT.

Lines in **OFF-SHORE DRILLING** operations need joint protection equivalent to the mill-wrapping on the pipe. TAPECOAT is most economical because it gives lasting protection in underwater service.



AIRPORT FUEL LINES need the quality joint protection assured by TAPECOAT. It is easy to apply by spiral or "cigarette" wrapping depending on the size of the pipe. No training needed.

UNDERGROUND GAS STORAGE facilities can be "buried and forgotten" when protected by TAPECOAT. Note protection of tanks, pipe and pipe joints.

STEEL MILL water lines in this new plant are joint-protected with TAPECOAT. TAPECOAT can be used to advantage to protect any steel surface in underground service, as proved since 1941.

Lines buried in cinders in **RAILROAD YARDS** need the sure protection provided by TAPECOAT. There's a size for every purpose from 2" to 24" in width.

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GIVE TWICE THE CAB, FENDER AND RADIATOR LIFE!

Rugged Ford Heavy Duties utilize heavier gauge steel, sturdier reinforcements, and a new independent mounting system to separate cab, fenders and radiator. This stronger construction, with each component *individually* frame-supported, doubles cab, fender and radiator life—cuts downtime delays and maintenance expense.

CAB—A 25% heavier floor pan and toeboard provide a solid base for greater cab durability. New full-length door pillar reinforcements and stronger inner door panels minimize door sag. New triangular mounts keep cab level and protect it from frame-movement stresses.

FENDERS—Ford fenders are 25% heavier gauge, too. They are bolted to a rubber-cushioned transverse support in front for needed flexibility. Fender-wide rear brackets provide necessary rigidity. The removal of only 8 bolts permits pulling the fender for rapid access to engine.

RADIATOR—New Ford "lock-seam" construction doubles the solder area on key seams, and heavier gauge tank and header walls provide increased radiator strength. "Horse collar" mounting on rubber pads soaks up vibrations and diagonal braces at sides give solid support.

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You save from the start with Ford's traditionally low prices, and your savings continue with low operating and maintenance costs. These facts are documented by certified test reports from America's foremost independent automotive research firm. Ask to see these reports. They're on file at your Ford Dealer's.

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INTERNAL LINE-UP CLAMP

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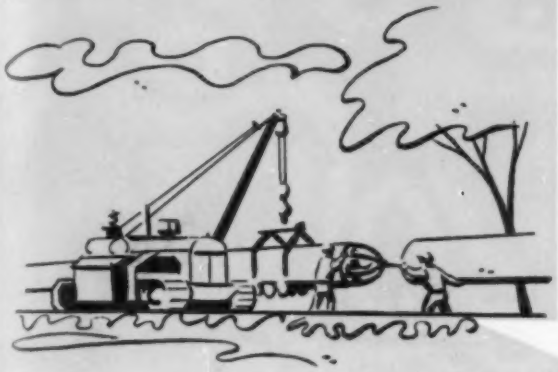

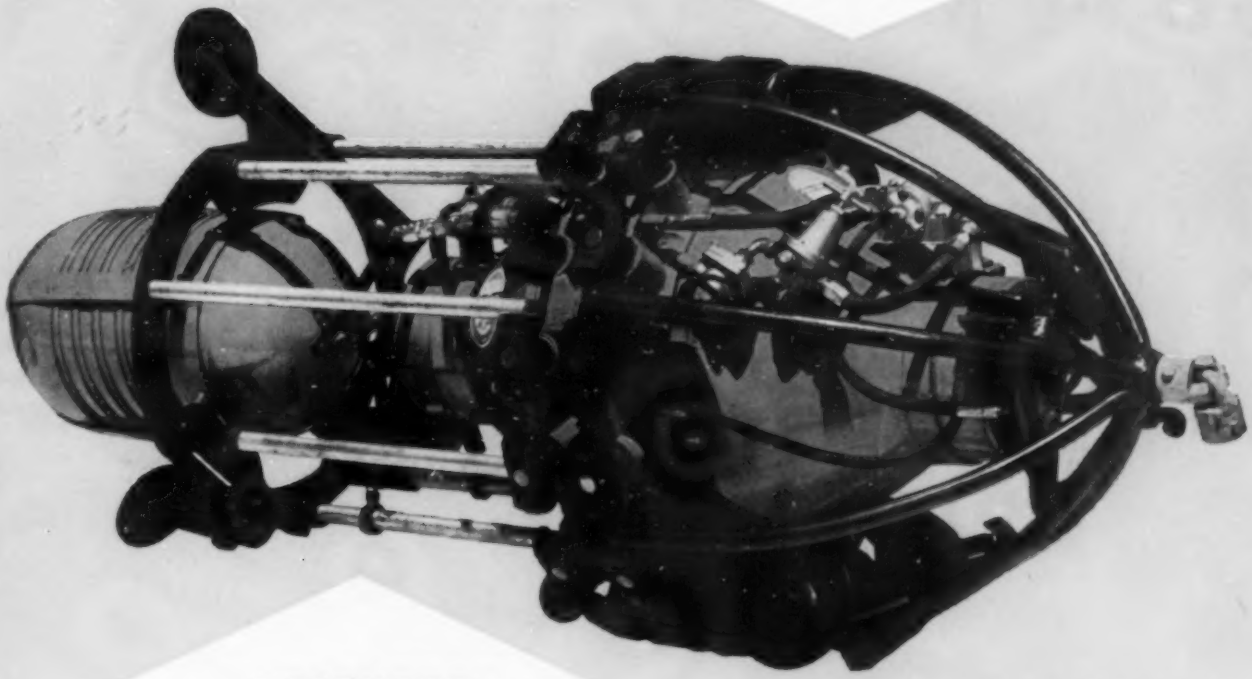

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- most powerful in the industry
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- has large diameter, ball bearing wheels for easier and faster movement of clamp
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CROSE-PERRAULT LINE-UP CLAMPS HAVE LINED UP MORE MILES OF PIPE THAN ALL OTHERS COMBINED.

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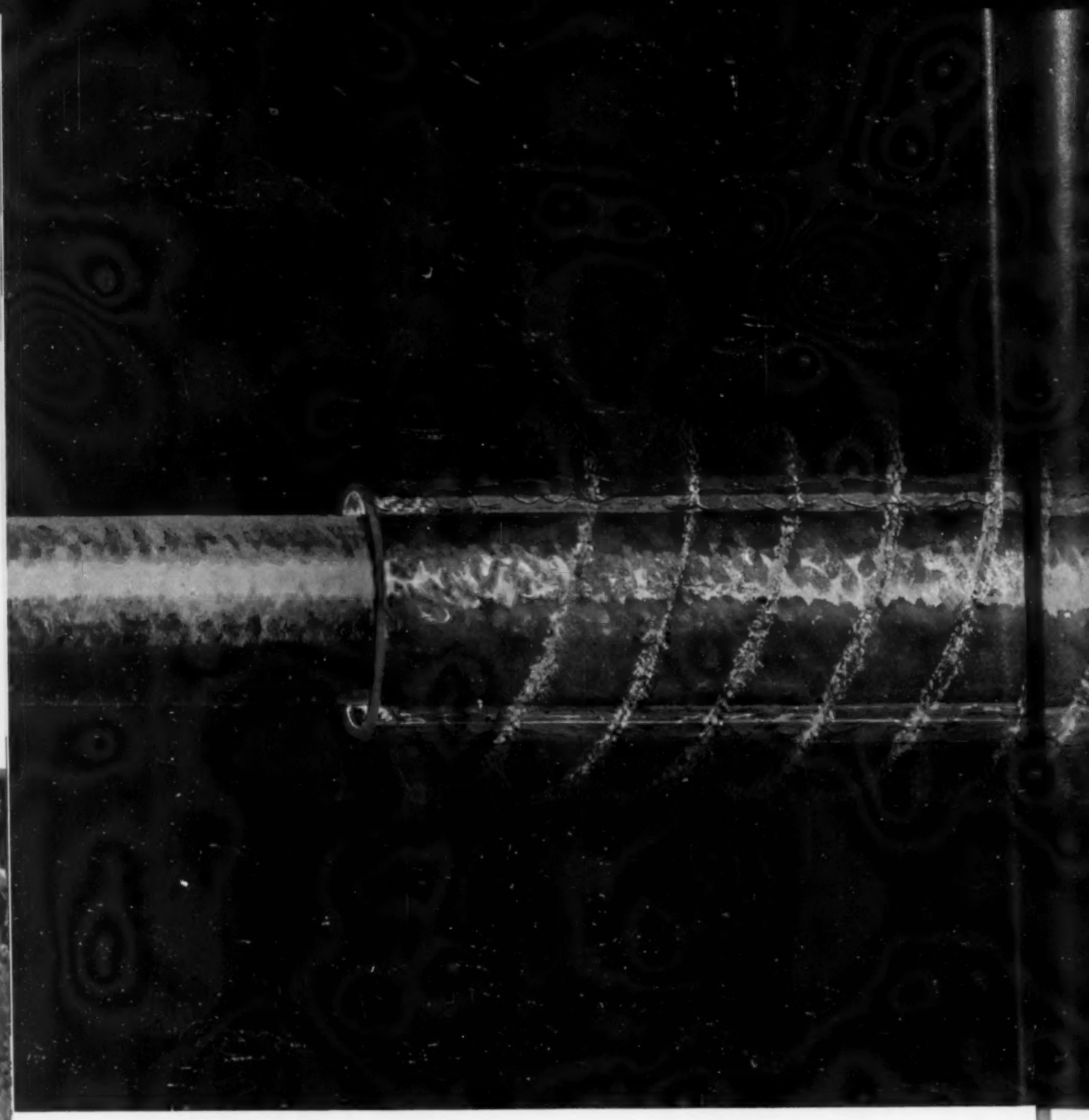

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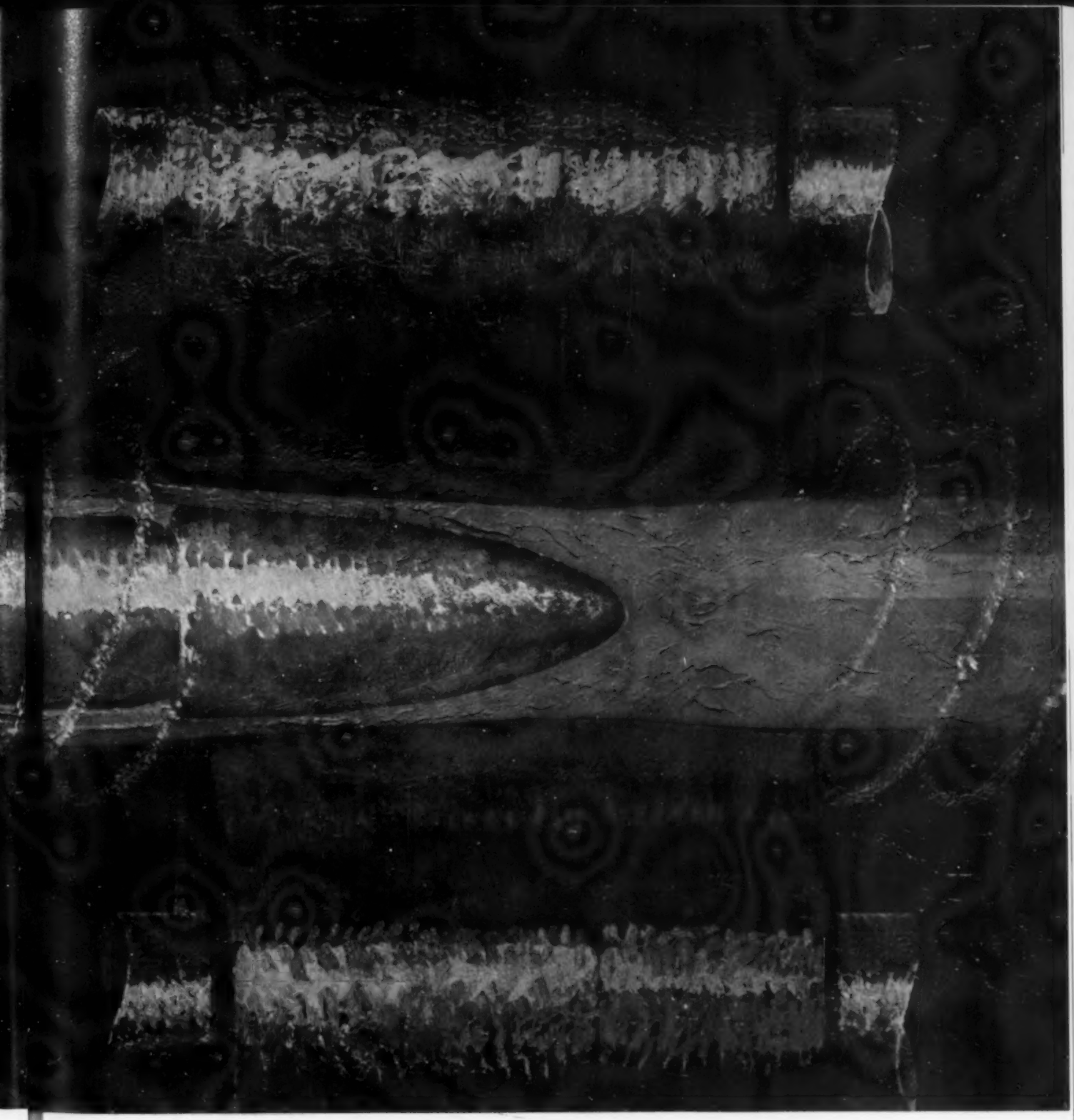
This mark tells you a product is made of modern, dependable Steel.



The piercing operation is one of the first steps in creating seamless line pipe from a solid section of steel. After we set the hot steel billet in place, we ram it. Spin it. Push its insides out. And stretch it into a tube many times longer than the original piece of steel.

Consider this grueling way that USS National Seamless Line Pipe is made. Need we say more about its strength or dependability? You can see why Seamless is the safest pipe in the world.

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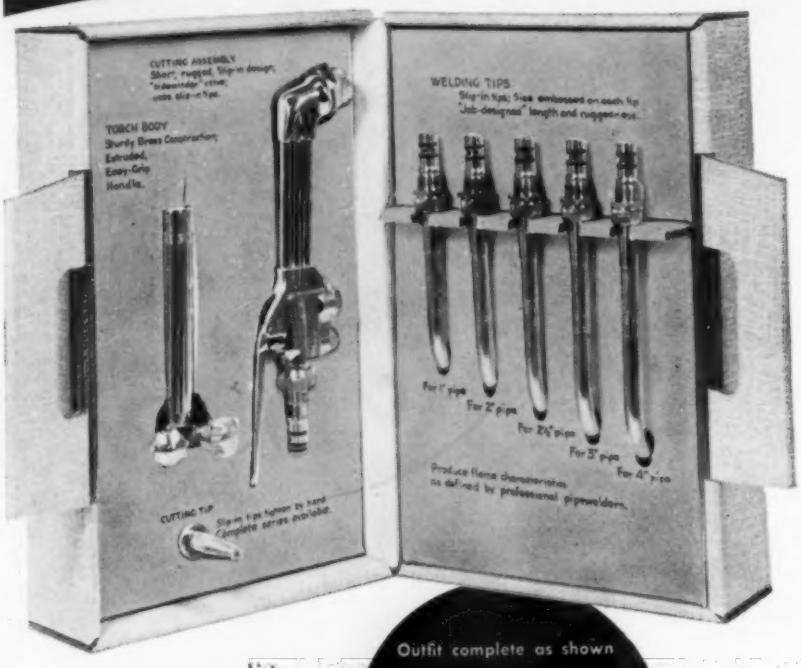

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Two years ago we retained a staff of professional pipewelders to tell us what features they needed in an outfit. One that would best perform the special jobs of the trade. We've been working closely with them since then . . .

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Outfit complete as shown

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"Special" Outfit	List Prices
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PW306 Weld Tip	5.00
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PW309 Weld Tip	5.00
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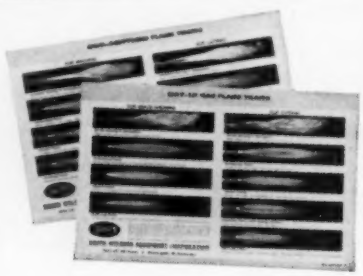
Total	87.25

- **WELDING TIPS**—tips slip-in and nut hand tightens, hex also provided on nut; tip rotates 360°. Short design with rugged copper section; precision flame stability. Recommended pipe size embossed on each of 5 tips.
- **TORCH BODY**—extruded "easy-grip" handle with brass forged butt; ball-type needle valves. Available in two lengths for operator preference.
- **CUTTING ASSEMBLY**—Slips into torch body, nut hand tightens; lever flips up for unrestricted access to nut; 75 or 90 degree head available.
- **CUTTING TIP**—Slips in, head nut hand-tightens. Complete series available.



New! 4-color wall charts showing flame traits of oxy-acetylene and oxy-LP gas in cutting, welding and brazing. Yours for the asking. See your Smith distributor or write Smith's.

Your Smith distributor has it in stock now . . . and if you like its looks and performance, you can buy it at a most attractive price.

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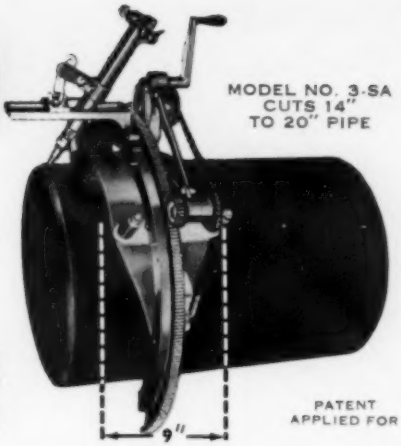

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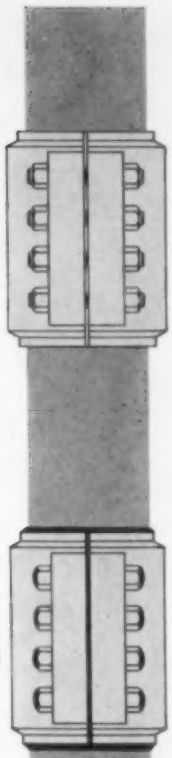

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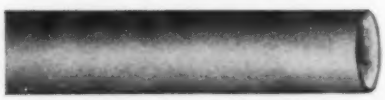

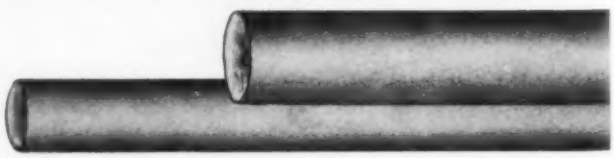

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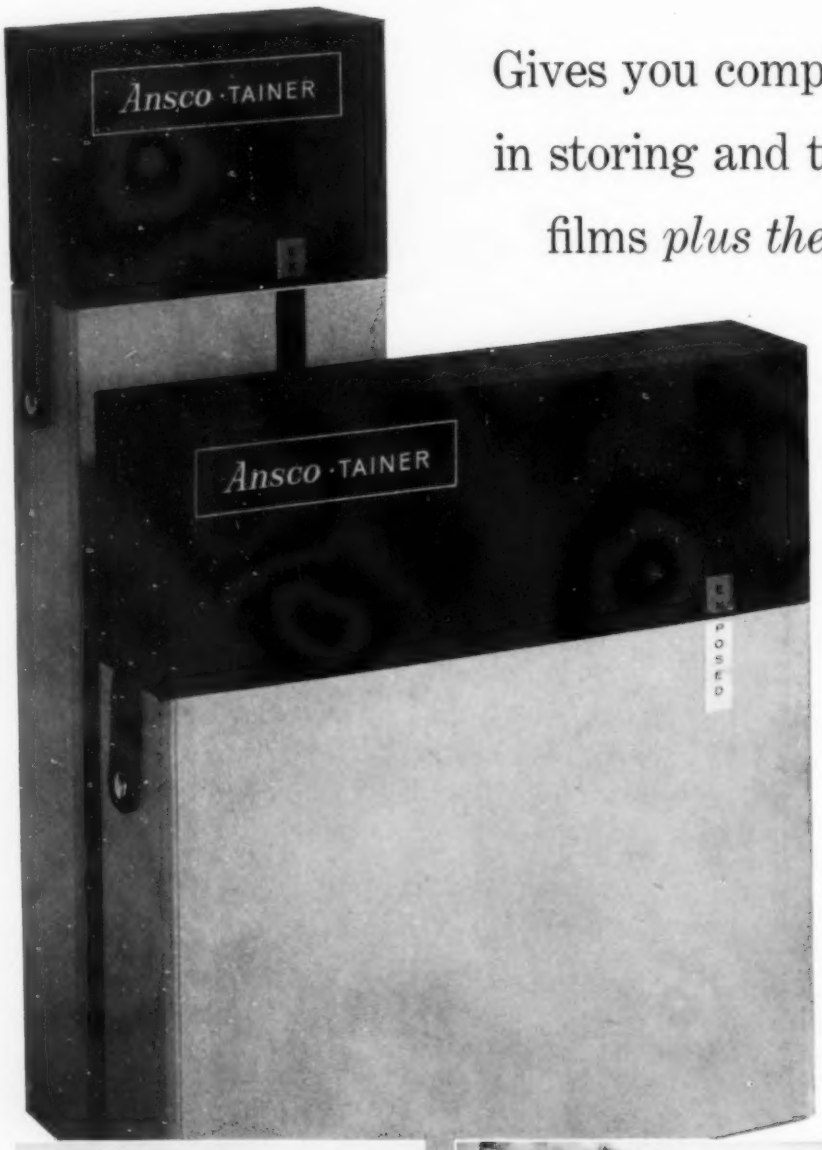

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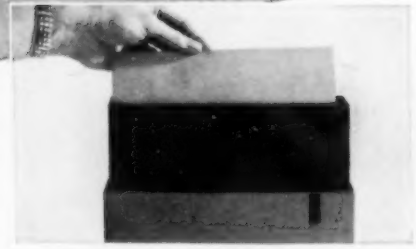

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PIPE LINE PANORAMA

Humble to Sell Gas Interstate . . . Pending federal approval, Humble Oil and Refining Company may soon: (1) Break longstanding aversion to selling its gas interstate. (2) Be one of very few natural gas producers to join in establishing an interstate gas pipe line. (3) Complete largest sale of in-place gas reserves ever made. (4) Make huge new supply of gas available to consumers in Ohio, Pennsylvania, West Virginia, Virginia, Kentucky, New York, Maryland and District of Columbia.

Humble entered interstate gas pipelining, at least temporarily, with announcement that it will join Lehman Brothers, New York investment firm, in forming Monterey Gas Transmission Company. Columbia Gas System, which serves above Northeastern states, announced at the same time that it would purchase gas under long-term contract. According to present plans, Monterey will:

- Purchase 6.2 trillion cubic feet of Humble's Southwest Texas gas reserves—3.5 trillion now, the rest later.
- Purchase Humble's present 30-inch, 238-mile line from Humble's King Ranch gas plant to its Clear Lake gas plant near Houston.
- Construct a new 30-inch, 216-mile line from Clear Lake to Alexandria, La., where it will tie in with Columbia Gulf's line.
- Ultimately transport more than 700 million cubic feet of gas per day from Southwest Texas to Alexandria, for sale to United Fuel Gas Company, principal supplier to Columbia Gas System companies.

Clear Span Erects World's Longest Aerial Span . . . Designed for Champlin Oil and Refining Company, the 2,749-foot crossing swings above the Missouri River from the world's tallest tower to be erected in one piece. The tower on one side of the Missouri is of nominal height, on the other side it is 278 feet high! Highest tower was erected in little more than an hour.

How to Reduce Evaporation Loss . . . Estimates are that crude oil evaporation losses in the the U.S., from wellhead to refinery gate, total $75 million. When products storage is included, total soars to $250 million. This flagrant waste is occurring despite many excellent methods now available to conserve hydrocarbons, i.e., floating roof tanks, vapor compression systems, P/V vents, variable vapor space systems.

New developments include: Microballoons and plastic floating roof tanks. From these methods, each pipeliner, producer or refiner can select the one most economically suited to his situation.

Ohio Oil reports it has cut evaporation loss of crude oil in 400 tank installations 85 percent in seven years, for annual saving of $250,000. **Method Microballoons.**

Used as a protective plastic foam layer ½-1 inch thick, the tiny, hole-free microscopic bubbles of urea formaldehyde or phenolic resin filled with inert gas, are about 800 times smaller than a ping pong ball. Spaces between microballoons become chocked with higher boiling components of the crude, greatly reducing evaporation.

Payout period: Less than one year. Life expectancy: 20 years.

PART 1

Trunkline Reports on Low-Cost Sa

Engineers found a consistent gain in "E" factors on test sections of 4, 8, 26 and 30-inch pipe lines.

By Adrian W. McAnneny, Manager for Engineering Planning
and Lester C. Sullivan, Supervising Engineer, Research & Development
Trunkline Gas Company, Houston

TRUNKLINE GAS COMPANY engineers recently completed a series of tests on sections of 8, 26 and 30-inch pipe lines which indicated that internal sandblasting of pipe lines can bring substantial increases in gas flow. The results of the tests can best be described in terms of the Panhandle A gas flow formula:

Formula "E" factors were consistently raised from about 86 percent to about 101-102 percent!

Pipe sections with E factors as high as 95 percent were also raised to about 101-102 percent. Transmission factors for 26-inch lines were increased from an initial range of 19.3-20.5 to a consistent final value of 22.5, which represents increases of from 10-16.5 percent depending upon the initial condition of the pipe. **All pipe tested to date has ended with about the same final "E factor" regardless of its initial value.**

Background. Sandblasting of small diameter pipe lines from 2-inch to 8-inch has been used for several years by oil producing companies for the removal of paraffin, BS & W, rust, scale, etc. The technique has also been used on small diameter pipe for surface preparation prior to in-place coating. Trunkline engineers felt that if the method were applicable to large diameter pipe, an improvement in transmission factor could be reasonably anticipated.

The work of the U. S. Bureau of Mines as revealed in Nomograph 9 indicated that in the *turbulent* flow region transmission factor was a function of surface roughness and independent of Reynolds number. Numerous tests performed on the Trunkline system fully substantiated their findings. In view of this, improvement in transmission factor could be reasonably expected if the pipe walls could be made smoother.

How It Works. How could sandblasting be expected to smooth the pipe surface, when it is commonly used to roughen a metal surface to provide an anchor pattern for paint? The answer lies in the mechanics of the method: with the pipe line opened to atmosphere at one end, a mixture of low-pressure gas and sand is admitted at the other end, and the sand is blown through the pipe. With this arrangement the Reynolds number is held to a low value, and the system is in smooth flow.

Thus, the sand grains strike the walls at a very small angle, and instead of tearing the metal, they gently polish it. It is this action which removes rust, scale, dirt, oil, sludge, corrosion products and the high spots on the pipe itself.

Prior to Trunkline's tests, the largest diameter pipe which had been sandblasted was 8-inch, and the longest line was only a few miles; so it was logical to start

Equipment set up to start sandblasting job. Truck has 25,000 pounds of sand, about a capacity load for the mixing tank.

Sandblasting That Increases Gas Flow!

Dirty sand pouring from open end of pipe gives indication of dirt, rust, oil, water, etc. picked up by high-velocity, turbulent sand. Gas flow is about 50,000 cfm for 30-inch. Sand was injected in 5,000-pound slugs.

additional work with tests on a small diameter pipe to determine some of the technical aspects of this new cleaning technique.

PURPOSE OF TESTS ON SMALL DIAMETER PIPE

Objectives. The object of the sandblast cleaning and flow tests was to determine the feasibility of sandblasting as a satisfactory pipe cleaning method, and to define the parameters which would permit an intelligent prediction of the applicability of this method to larger diameter pipe. A second objective was to determine what increase in flow efficiency could be anticipated on large diameter pipe. There were numerous factors which needed investigation, and numerous questions that needed answers before reliable extrapolations to large diameter pipe could be made with confidence.

THE UNKNOWNS

Motive Power. Air had been used as the motive power or carrying agent in all previous in-place sandblasting. The problem of condensation inside the pipe line as a result of expansion cooling gave rise to many problems including the immediate formation of rust due to a highly reactive steel surface in the presence of oxygen and moisture. The moisture also had certain effects on the sandblasting procedure and gave results which were not always consistent. Trunkline proposed to use natural gas in lieu of air as the motivating force, thus eliminating condensation as a factor. Of course there are some natural gases which could give rise to hydrocarbon condensation. Calculations indicated that this would not be a problem with the gas to be used on the proposed tests.

The Sand. Other unknowns concerned the sand itself. Should the sand be coarse grain, fine grain? At what rate should it be injected? How much should be injected? Would the sharpness of the sand be reduced to such a degree that no cleaning action would be obtained after it had traveled a few miles down the pipe line? Suppose liquids were encountered in the low spots in the line, would the sand fall out to be deposited and clog the line? Another pertinent unknown concerned deposition of sand in the line which could ultimately damage compressor valves, rings, liners, rods and packing.

The Pipe. The third factor was the pipe. Would the pipe be damaged by the passage of sand? It is obvious that if there are any significant bends in a pipe line, the sand will impinge on the back side of the bend and erode it. It was very important that information be obtained on this aspect of the problem.

Flow Factors. The primary objective in sandblasting a gas pipe line was to obtain an increase in transmission factor. Thus, the flow characteristics had to be studied before and after sandblasting to determine the change, if any. In the event improvement was obtained, engineers had to resolve the question as to whether or not this improvement could be maintained.

Corrosion. When a steel surface has been abraded or polished, it is very reactive chemically. Would this surface be corroded by constituents in the gas, or would they form a protective film? Should an inert chemical film such as a phosphate, sulfide or chromate be deposited immediately after blasting? Perhaps some type of paint might be applied to maintain the smooth surface. Also, what would be the effects of compressor cylinder lubricating oil on the surface, of hydrocarbon condensate, and adventitious waters?

These were the unknowns in the application of the sandblast technique to natural gas pipe lines. Answers to all of the above items have not yet been answered. However, enough has been learned to state that sandblasting can now be used as a routine tool in pipe line cleaning and maintenance programs.

SUMMARY OF TESTS ON FOUR-INCH PIPE LINE

Surface Roughness. Three types of pipe were actually involved in these tests: seamless, resistance weld and lap weld. The test section consisted of about 500 feet of seamless and 2000 feet of lap weld. Six test nipples, three of each type pipe, were placed in various locations along the test section. Relative surface roughness tests were made on the six test nipples before and after the sand was run.

These measurements indicated a reduction in relative roughness to about 35 percent of the original value for

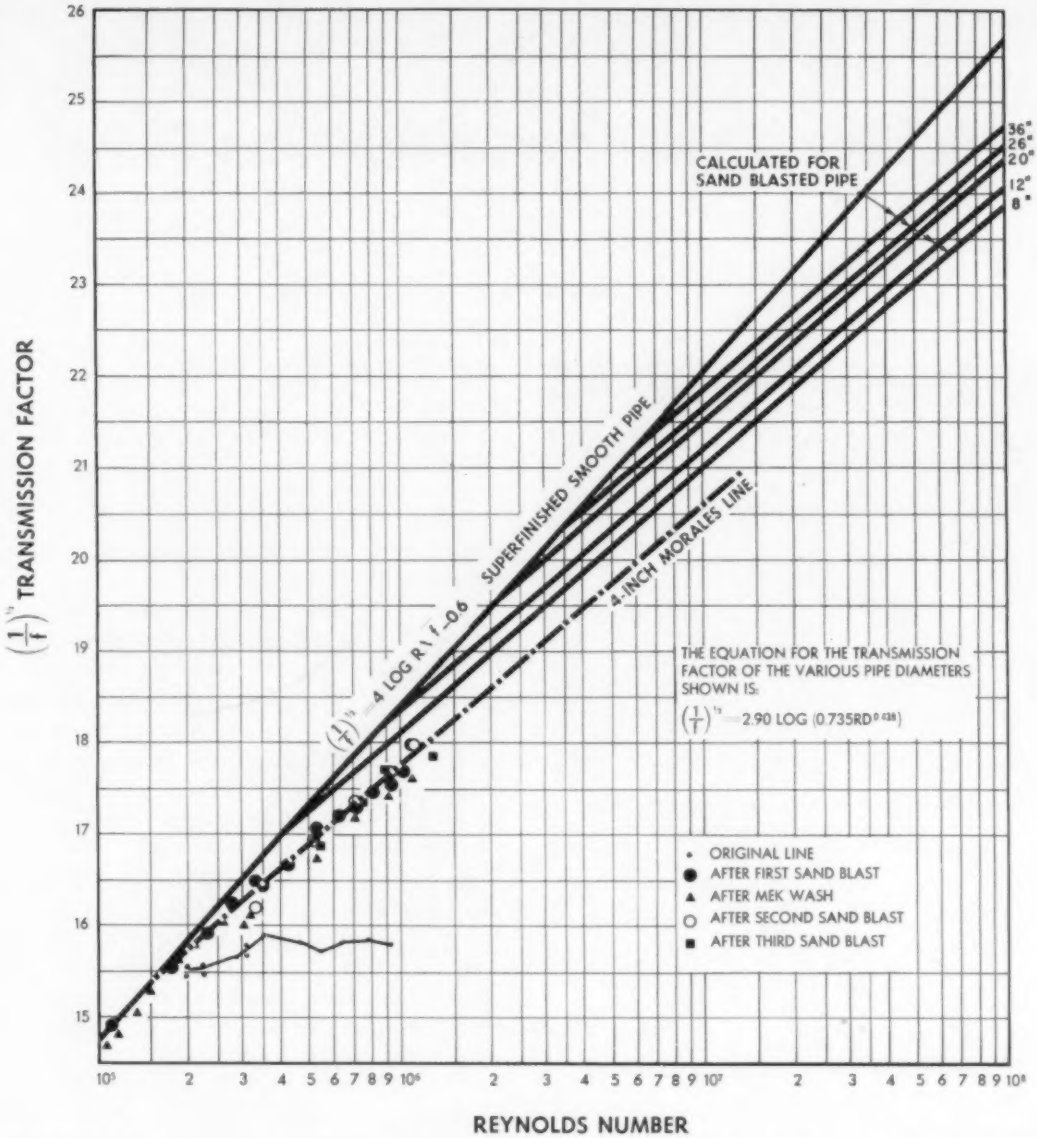


FIGURE 1—Here are the results of tests on a half-mile section of four-inch gas line. About 500 feet of pipe was seamless; 2,000 feet was lap weld. Test nipples were spotted along the length to measure wear and smoothness.

the resistance weld pipe and about 55 percent for the seamless pipe. The seamless pipe was extremely rough along the internal periphery, but was relatively smooth along the longitudinal axis of the pipe.

TRANSMISSION FACTOR

This reduction in internal pipe surface roughness is reflected by the change in transmission factor as indicated in Figure 1. The transmission factor obtained on the original pipe prior to sandblasting at a Reynolds number of 1,000,000 was about 15.8. After sandblasting the transmission factor increased to 17.7 or an increase of 12 percent. On a 26-inch line, this same order of increase could be expected at a flow of about 400 MMSCFD.

It is extremely important to note the change in the character of the transmission factor curves before and after sandblasting. The usual transmission factor curve follows the "smooth pipe flow" law at low Reynolds numbers as formulated by Nikuradse and von Karman and further confirmed experimentally on superfinished pipe by Smith in Bureau of Mines Nomograph.

At higher Reynolds number or in the "turbulent flow" region the transmission factor becomes constant and has no Reynolds number dependency. The transmission factor for a given diameter pipe is solely dependent on the absolute roughness of the pipe. Between the smooth and turbulent flow regions there is a transition region which is difficult to define mathematically. These three regions are clearly shown on Figure 1 for the 4-inch line tested. However after sandblasting it is very clear that the transmission factor has a Reynolds number dependency rather than one of surface roughness. It is this shift in flow characterization that provides the large increase in capacity that is obtained by sandblasting the pipe to a smooth condition.

Following the first 30-minute sandblast and flow test, a test spool piece was removed from the center section of the pipe line. The pipe was very clean, smooth and bright. A very fine powder could be wiped off with the finger. The spool was replaced and the pipe line was washed with two 30-gallon slugs of methyl ethyl ketone. The first slug came out discolored while the second slug came out relatively clean, indicating that the powder

had been removed. A flow test was made after this washing process; and as shown by the triangles plotted on Figure 1, the transmission factor was lowered slightly at the high Reynolds number. This reduction is slight and not considered significant.

The 30-minute sandblast following the MEK wash improved the transmission factor slightly, while the next 30-minute sandblast caused no change. The results of these two tests are plotted on Figure 1.

PIPE WALL EROSION AT 90 DEGREE ELBOW

The wall thickness of a 90-degree elbow was measured before being placed near the end of the pipe line. After the third sandblast it was again measured, and the maximum reduction in wall thickness was 0.030-inch. This elbow was subjected to the worst conditions on the line, the sand impinged on the back side of the elbow at maximum velocity. Most large diameter pipe lines have a maximum bend of about 1.5 degrees per pipe diameter.

EFFECT OF BLAST ON SAND PARTICLES

Sieve analysis of sand samples before and after blasting are shown in Table 1 below:

Table 1
SIEVE ANALYSIS

SAND BEFORE SANDBLASTING	
SIEVE SIZE	% RETAINED
30	0.1
40	26.8
50	85.6
70	98.8
80	99.3
100	99.5
140	99.8
200	100.0

SAND AFTER SANDBLASTING	
30	0.1
40	13.6
50	53.0
70	74.2
80	76.9
100	79.6
140	86.5
200	89.9

It is obvious that the sand was reduced in size as a result of its travel through the line. In fact, about 10 percent of the sand was reduced to such size that it passed a 200-mesh sieve, and the percent retainage on the 70-mesh sieve was reduced from 98.8 to 74.2 percent. **However, microscopic examination of the used sand revealed that it was much sharper than the original sand.**

The original sand appeared to be relatively smooth. This increase in sharpness is due to fracturing of the sand along the crystal planes resulting in very sharp edges. Both new and used sand retained on the 40 and 50-mesh sieves appeared to be quite similar in appearance and smoothness. Undoubtedly the portion of the used sand which passed the 200-mesh sieve contained much of the product which was removed from the pipe wall and ground up by the sand. The sand particles in this fine dust were extremely sharp. These observations indicate that the effectiveness of the sand is not lost as it moves down the pipe. On the contrary, its increased sharpness and velocity enhanced its ability to clean and polish the pipe interior, making it more effective.

Examination of the test nipples under the microscope revealed that the upstream nipples were not as smooth as the downstream nipples. This is probably accounted for by the difference in sand particle size and velocity at the two test nipple locations. This is also indicative that it may be desirable to blast from each end of a pipe section to insure that high velocity sand particles give maximum polish to the entire pipe section. Another alternative would be to reduce the length of pipe blasted such that there is less relative difference in the sand velocity at the inlet and outlet.

TEST PROCEDURE

The 4-inch pipe used for this test was approximately one-half-mile long. Test spools were placed at the quarter points on the line to observe the interior of the line after each sand blast and the MEK wash. Surface roughness of these test spools was measured before and after the sand blasts. All flow tests were made by admitting gas at various inlet pressures and permitting it to blow to the atmosphere at the other end. A standard 4-inch meter run was used for measuring flow; the orifice plate was changed as required by the flow. Static pressure was measured with either a calibrated dead-weight tester or a mercury manometer depending upon the pressure. Differential was measured with a mercury manometer in all cases. Pressure on the line was also measured with a dead-weight tester or mercury manometer as required. All temperatures were obtained with laboratory type precision mercury thermometers. The maximum inlet pressure used during the flow tests was about 70 psig, thus all flow tests must be considered as low pressure tests.

Surface roughness measurements were made with a Brush Surfindicator. The instrument reads the arithmetical mean value rather than the peak to peak value.

EXTRAPOLATION OF SAND BLAST TESTS ON 4-INCH LINE TO A 26-INCH LINE

Transmission Factor. It will be noted on Figure 1 that after sandblasting, the transmission factor of the 4-inch line intersects the curve of the "smooth pipe flow law" at a Reynolds number of 150,000 and a transmission factor of 15.4. Any Reynolds number above this value gives a transmission factor which is less than that for a perfectly smooth pipe. The difference between the two curves can be attributed to such items as **stringer beads, icicles, overbends, sidebends** and **sags.** If transmission factor is a function of pipe surface roughness as described in U.S. Bureau of Mines Nomograph 9, then it is apparent that the flow tests on the 4-inch line were not run at sufficiently high Reynolds number to encounter this effect. Conversely, the pipe is so smooth that higher Reynolds numbers must be encountered before this effect is noted.

Extrapolation to a 26-inch line requires that the above items be considered. The 4-inch was a straight pipe line one-half mile long with no bends anywhere along its length. The only difference between a straight 26-inch

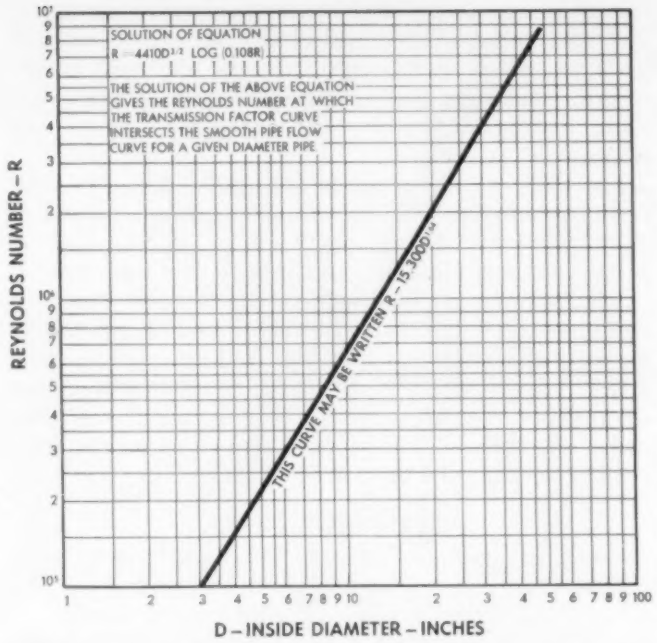

SOLUTION OF EQUATION
R = 4410D^1/2 LOG (0.108R)
THE SOLUTION OF THE ABOVE EQUATION GIVES THE REYNOLDS NUMBER AT WHICH THE TRANSMISSION FACTOR CURVE INTERSECTS THE SMOOTH PIPE FLOW CURVE FOR A GIVEN DIAMETER PIPE
THIS CURVE MAY BE WRITTEN R = 15,300D^5/4
REYNOLDS NUMBER - R
D - INSIDE DIAMETER - INCHES

FIGURE 2—The values shown here were calculated for pipe diameters from 4 to 36 inches; thus, for any pipe diameter, the Reynolds number corresponding to the point of intersection of its transmission factor curve with the smooth pipe flow curve, may be read directly.

and the 4-inch tested would be the effect of the stringer beads and icicles if both pipe sizes had the same absolute surface roughness. It is apparent that because of the geometry, stringer beads and icicles should have more effect on the transmission factor of a 4-inch line than a 26-inch line. Thus a conservative estimate of 26-inch performance can be predicted from the results on the 4-inch pipe on a Reynolds number basis. On extrapolation based on Reynolds number seems justified in view of the high degree of geometrical similarity brought about by two different diameter pipes having the same degree of smoothness.

Consider the 4-inch transmission factor curve where it intersects the "smooth flow" curve at a Reynolds number of 150,000. If the 4-inch line were replaced by a 26-inch line and the inlet and outlet pressures were held constant, then the 26-inch line should have a Reynolds number which would represent the intersection of its transmission factor curve with the "smooth pipe flow" curve. This value of Reynolds number can be found as follows:

$$R_4 = \frac{AQG}{D_4} \qquad (1)$$

Where:

A = A constant depending on units used
R_4 = Reynolds number in the 4″ line
Q_4 = Volume flow in 4″ line
G = Gravity of gas (Air = 1)
D_4 = Internal diameter of 4″ line

Because the flowing temperature, compressibility and specific gravity are the same regardless of pipe diameter, the equation for the throughput is given by:

$$Q_4 = K\left(\frac{1}{f_4}\right)^{1/2}\left(\frac{P_1^2 - P_2^2}{L}\right)^{1/2} D_4^{5/2} \qquad (2)$$

Where:

K = A constant depending on units used
f = Friction coefficient
$\left(\frac{1}{f}\right)^{1/2}$ is called "Transmission Factor"
P_1 = Inlet pressure PSIA
P_2 = Outlet pressure PSIA
L = Length of pipe

Thus for any pipe diameter D

$$\frac{R}{R_4} = \frac{QD_4}{Q_4D} \qquad (3)$$

For the same pressure drop and length from (2)

$$\frac{Q}{Q_4} = \left(\frac{\frac{1}{f}}{\frac{1}{f_4}}\right)^{1/2}\left(\frac{D}{D_4}\right)^{5/2} \qquad (4)$$

Substituting $\frac{Q}{Q_4}$ from (4) in (3) above gives

$$R = R_4\left(\frac{\frac{1}{f}}{\frac{1}{f_4}}\right)^{1/2}\left(\frac{D}{D_4}\right)^{3/2} \qquad (5)$$

From measured and experimentally determined data

$\left(\frac{1}{f}\right)^{1/2} = 15.4$
$R_4 = 150{,}000$
$D_{26} = 25.375''$
$D_4 = 4.02''$

And assuming some value for $\left(\frac{1}{f}\right)^{1/2}$ which lies on the smooth pipe flow curve, calculate R_{26} and see if it corresponds to the assumed value of $\left(\frac{1}{f}\right)^{1/2}$ on the smooth pipe flow curve. Several trials give the result that the point of intersection of the 26-inch with the smooth pipe flow curve occurs at a Reynolds number of 3,120,000 and a transmission factor of 20.18. This same procedure may be used to determine the point of intersection for any diameter pipe. The transmission factor for any Reynolds number may be found by drawing a line through the calculated point parallel to that of the 4-inch line. Such a line is shown for several pipe diameters on Figure 1.

Equation 5 may also be solved by substituting the smooth pipe flow equation for $\left(\frac{1}{f}\right)^{1/2}$. The smooth pipe flow equation is given by

$$\left(\frac{1}{f}\right)^{1/2} = 4\ \text{Log}\ [R(f)^{1/2}] - 0.6 \qquad (6)$$

This is an implicit equation and does not lend itself readily to mathematical manipulation. It may be rewritten in an explicit form for ease in handling. While this form tends to lose the identification with its derivation, it gives results accurate to four significant figures down to a Reynolds number of 100,000. Reynolds numbers below 100,000 are rarely of any interest in the gas

transmission industry. The explicit form of this equation may be written

$$\left(\frac{1}{f}\right)^{1/2} = 3.65 \text{ Log } (0.108\ R) \qquad (7)$$

Substituting this value of $\left(\frac{1}{f}\right)^{1/2}$ in equation (5) and rearranging gives

$$\frac{R}{\text{Log } (0.108\ R)} = \frac{3.65}{\left(\frac{1}{f_4}\right)^{1/2}} \left(\frac{D}{D_4}\right)^{3/2} R_4 \qquad (8)$$

From measured data

$\left(\frac{1}{f_4}\right)^{1/2} = 15.4$

$R_4 = 150{,}000$

$D_4 = 4.02$-inch

Substituting these values in equation (8) gives:

$$R = 4{,}410\ D^{\frac{3}{2}} \text{ Log } (0.108\ R) \qquad (9)$$

From this equation for any given pipe diameter a value of R can be found by trial and error which will determine the point of intersection with the smooth pipe flow law. Values of Reynolds numbers were calculated for pipe diameters from 4 to 36-inch and plotted on Figure 2. Thus for any pipe diameter the Reynolds number corresponding to the point of intersection of its transmission factor curve with the smooth pipe flow curve may be read directly. A line drawn through a point established in this manner parallel to the line determined experimentally for the 4-inch gives the transmission factor curve for that diameter pipe.

The equation for the curve from Figure 2 may be written

$$R = 15{,}300\ D^{1.64} \qquad (10)$$

from which the Reynolds number corresponding to the point of intersection may be directly calculated for any given pipe diameter.

The equation for the transmission factors for a 4 and 26-inch pipe obtained from Figure 1 are:

$$\left(\frac{1}{f_4}\right)^{1/2} = 2.90 \text{ Log } 1.33\ R_4 \qquad (11)$$

and

$$\left(\frac{1}{f_{26}}\right)^{1/26} = 2.90 \text{ Log } 2.94\ R_{26} \qquad (12)$$

These equations only apply for a Reynolds number greater than that corresponding to their respective intersection with the "smooth pipe flow" curve. For lesser values of Reynolds number the transmission factor is given by the smooth pipe flow law.

The above two equations differ only by a constant. The difference between the constants must be attributed to a diameter factor. In an effort to correlate these two curves, it was assumed that the ratio of these constants would bear some relation to the ratio of the diameters raised to some power. Thus,

$$\left(\frac{25.375}{4.02}\right)^{x} = \frac{2.94}{1.33}$$

Solving for x gives $x = 0.428$

Equation 11 may now be written:

$$\left(\frac{1}{f}\right)^{1/2} = 2.90 \text{ Log } \left[\left(\frac{1.33}{(4.02)^{0.428}}\right)^{0.428} D\ R\right] \qquad (13)$$

$$= 2.90 \text{ Log } (0.735\ D^{0.428} R)$$

which is a general expression for the predicted transmission factor of any internally smooth pipe line of diameter D for Reynolds numbers greater than that corresponding to the point of intersection with the smooth pipe flow curve.

(The authors will describe the actual results obtained by sandblasting sections of large diameter flow in Part II of this article.)

About the Authors

McAnneny

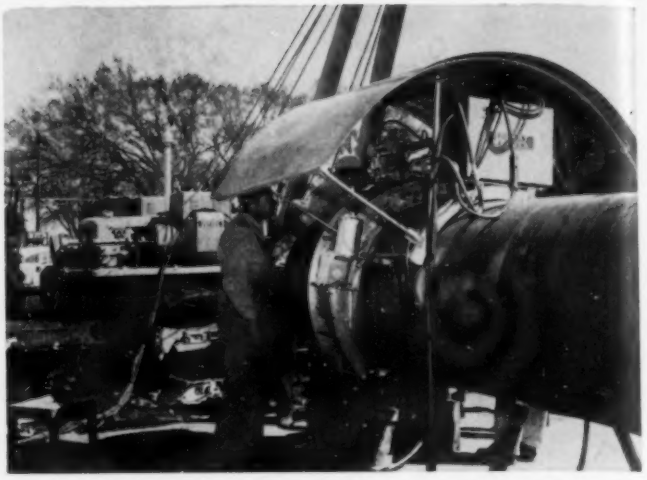
Sullivan

Adrian W. McAnneny joined Trunkline Gas Company in 1954 after spending two years each with Fish Constructors and Giffels & Vallet Engineering Company. He is presently manager for engineering planning.

McAnneny was graduated from Rice University in 1938 with a degree of B.S. in E.E. As an electrical engineer with Texas Pipe Line Company until 1950, he was engaged in corrosion research and control, pump station electrical design and pump station construction. He served four years in the U.S. Air Force during World War II as an engineering officer and research and development engineer.

Lester C. Sullivan, supervising engineer for research and development at Trunkline Gas Company has been employed by the Houston-based gas pipe line firm for 5½ years. A native of Springfield, Mo., he received his B.S. degree in mechanical engineering from Texas A&M College. Before joining Trunkline Gas, Sullivan worked two years as technical service engineer for El Paso Natural Gas Company. Earlier, he worked two years for Texas Electric Service Company of Fort Worth. He served in the U.S. Air Force as a flight engineer during both World War II and the Korean War.

AUTOMATIC WELDING MACHINE handles 36-inch pipe. Close-up shows welding head which makes two 12 o'clock-to-6 o'clock passes to complete welds on this pipe (7/16-inch wall thickness) in about 8 minutes.



Photographs Courtesy Hobart Brothers Co., Troy, Ohio

AUTOMATIC WELDING PROCESS is visible to operator at all times. This enables him to visually spot variables which are a normal part of right-of-way pipe welding, and to correct for them.

Another Automatic Welding Machine Here

THREE COMPANIES—a pipe line contractor, a pipe line supply and equipment company and a manufacturer of welding equipment—have combined their know-how and resources to come up with a welding machine which can weld pipe on the right-of-way. In an announcement, which follows close on the heels of a similar disclosure by Esso Standard and others (See March 1961, PIPE LINE INDUSTRY, page 26), the developers say the new machine has automatically welded 36-inch diameter API 5LX Grade X52 pipe of 7/16-inch wall thickness in less than eight minutes! The pipe is not rotated during the weld.

The developers of the new welder are H. C. Price Co., Crose-Perrault Equipment Corp. and Hobart Brothers Co.

Like the Esso machine, the new automatic welder uses CO_2 gas as a shield rather than conventional flux. Also, it uses a small diameter electrode wire—in the range of 0.035 to 0.045 inches in diameter. The arc voltage is low—in the neighborhood of 19 to 20 volts and the current ranges from 120 to 150 amps, DC reverse polarity.

The controls which operate the machine are operated by a pushbutton pendant.

Field tests on pipe line projects in Oklahoma and California have proved that the new machine can complete welds of large diameter, heavy-wall pipe at high speed. The pipe ends have conventional bevels and no special grinding or cleaning is necessary. No back-up rings are necessary. This procedure meets API codes for bending, X-Ray, etc.

In many respects, the welding procedure is the same as for conventional manual welding. The pipe ends are lined up with a standard gap, rounded out and held in place by an internal hydraulic line-up clamp. No tack welding is required. The lightweight, compact machine can be lifted and positioned over the joint by two men, but for field operation and convenience, a side-boom tractor will be used for this chore.

Travel speed of the machine when making the weld, as well as amperage and voltage, are preset. The operator visually lines the unit over the joint and adjusts the electrode position with the pendant control. The weld is visible at all times—even though the operation is fully automatic. The operator can control both the unit and the welding head to compensate for variables; he can shut the machine down by pushing a button on the control pendant.

Small diameter electrode wire has been used successfully in the past on semi-automatic and automatic roll welding of pipe as used in the double jointing yards. The key components in the process are an automatic wire-feeder and a source of constant voltage power.

It is the latter which makes the all position weld possible. The constant voltage principle is successful in minimizing the adverse effects of such problems as variation in root openings, variations in root-face on nose and normal problems with pipe misalignment.

The power source for the machine is a belt-driven 500 amp, constant voltage welding generator with a 12-KW auxiliary power generator which delivers 110/220 AC, single and three-phase current for operating drive motors. It can also be used for lights and other equipment on the spread. The generators are mounted on the side-boom tractor and belt driven from a power take-off.

All welding is "down-hill" starting at 12 o'clock and welding to 6 o'clock on both sides of the pipe. The second bead overlaps the first bead at both top and bottom. Welding speeds depend upon the wall thickness of the pipe.

The machine was first demonstrated publicly at the recent forty second annual AWS Welding Show in New York City.

CONTROL COMMUNICATIONS • INSTRUMENTATION

New Developments in Crude and Products Pipe Line Operations

Here are some striking innovations

By Fred S. Jones, Chief Engineer
Platte Pipe Line Company, Kansas City, Mo.

THE TECHNIQUES of pipe line operation have changed so rapidly in the past five years that it is difficult to keep up with them. However, some of the important changes are reflected in the statistics of our industry. And it is more than a good guess that the pipe line industry is now entering a period of accelerating evolution.

The biggest advance lies in the field of automation. In 1956, very few companies were using automation for unattended operations, although most of the major pipe lines had adopted interior pushbutton controls. Some had even installed matching remote control functions which could be selected or rejected by attending personnel. As a whole, the industry was undecided regarding the immediate feasibility of installing unattended pump stations.

But about this time, several companies achieved early technical successes with automation and the economic advantages of the new concept in pipe line operation were easily verified. The race was on!

By 1958, 32 percent of all crude and products pumping stations were using remote or automatic local control to varying degrees; 24 percent were unattended, 14 percent were partially attended.

In 1959, 35 percent were controlled remotely or automatically, 24 percent were unattended, 18 percent were partially attended. Construction in 1959 increased the total number of pump stations by 4 percent. It appears that all the new stations and some of the older ones were fitted with automation equipment during the year.

In 1960, remote and automatic control advanced to 37 percent, unattended operation sagged to 22 percent, but partially-attended operation increased to 21 percent.

Remotely controlled pumping horsepower more than doubled in the two-year period 1958 to 1960!

The above figures were taken from the annual Group 5A8 "Automation and Instrumentation" report submitted last fall to the Engineering and Technical Section of the Central Committee on Pipe Line Transportation of the American Petroleum Institute.

The changes reflected in the statistics above were accompanied by striking technical changes. As the number of applications increased, so did the efficiency of various installations and the quality of performance. Here are some of the recent innovations.

REMOTELY CONTROLLED TANK SWITCHING

Late in 1959 Platte Pipe Line Company revamped a tank installation so that any one of seven tanks could be switched from injection to receiving service as required. This involved the installation of remote control equipment to open and close 17 manifold and main-line valves which had previously been operated by station shift operators at Gurley, Neb., who followed the dispatchers' instructions.

Here are some of the innovations incorporated in this particular modification.

Telemetering Gravitometer. The station was already equipped with a direct-connected gravitometer including an in-station remote recorder. The recorder relay loop was rewired to utilize the continuous power supply afforded by the local microwave station. A remote telemetering relay and tone channel was added for transmitting gravity information to Kansas City where a recorder was added to permit the dispatcher to observe batch cuts at Gurley.

A temporary "cut" detector with an actuating switch mechanism was designed and constructed by Platte personnel to investigate and prove the effectiveness of a programed cut-actuated tank switching system and to provide for unattended tank switching while awaiting the deliv-

Automatic welding machine on construction job for Humble Pipe Line in West Texas. Operator checks pipe alignment; it is not necessary that the pipe be rotated. Process uses a CO_2 gas shield instead of usual flux.

ery of remote control equipment. This programer was crude but effective. A tank switching program could be set up several hours in advance of an interface and could be actuated by a rising or falling gravity as required. The programer was subject to local override on an elapsed time basis in case the "cut" was delayed by loss of pumping power upstream. It was also subject to a remotely actuated override, cancel, or initiate command from the dispatcher. The programer was taken out of service when complete remote control was installed but it did prove conclusively that local tank switch programing is feasible and effective. The same principle, although considerably simplified, is in constant use at two other receiving points on Platte's system at the present time.

Gurley Station is equipped with four 55,000-barrel, three 120,000-barrel tanks, which are assigned to storage for five different grades of oil. Each tank is filled and emptied through a common tank line connected to the incoming and the outgoing headers. Gurley has 2,600 horsepower in three different sized units; all units can be diverted from injection service to main line boosting service by remote control. The tank header block valves, the station suction valve, and the individual incoming and outgoing tank valves are all motor-operated and subject to remote control and supervision from Kansas City.

Tank Gaging. Gurley Station's original tank gaging system utilized tape-driven potentiometers and hand-calibrated meters. A new tank gaging system uses the existing potentiometer type transmitters with slight redesign. They are now interconnected with a new style analog to digital converter which converts a potentiometer derived voltage to feet, inches and eighths of inches for local readout. Remote transmission is accomplished over a slow speed on-off radio tone subchannel to the Dispatch Center at Kansas City. The existing remote control equipment was utilized for tank selection and the security level of the remote control system has proven adequate enough to eliminate the requirement of transmitting tank identification as a part of the tank level data chain.

Savings in Manpower. Remote control of tank switching is now in its third month of operation and one shift operator has already been transferred to another location. Platte anticipates that the station will be semi-attended by one or two station operators and, on a relief basis, by an area gager from an adjacent remotely-controlled injection station. If the operation proves out as designed, one more operator can be transferred to other duties, reducing the attending personnel to one resident operator and one part-time area gager. Before the Platte system was equipped with remote control, this station was attended by six full-time operators.

Conclusions. The decision to switch tanks by remote control is considerably more involved than the decision to remotely operate a multi-unit booster station. Platte has

operated with a high ratio of remotely-controlled stations for a number of years and has conclusively proved that such operation is economical and dependable, providing adequate protective devices are installed. The tank headers are protected with a pressure relief system and remote alarm. The tank valves are equipped with local electrical interlocks. A remote stop function is installed to allow instant stops and reversals if required. Booster pump controls are interlocked with the outgoing tank valves. When the tank valves crack open, the booster pump starts; when the tank valves close, the booster pump stops. Later this year, two-way three-port check valves will be installed in the tank lines, thus eliminating the need for manual prepositioning of the circulating line valves. The over-all task has been challenging but the first measures of success have been rewarding. Remotely controlled tank switching on the Platte system is now a reality.

HYDRAULIC SIGNAL PRESSURE CONTROL

Working with a leading manufacturer of hydraulic controls, Sinclair Pipe Line Company acquired a hydraulic signal pressure control system which provides precise pressure control at pump stations.

The new system came as a solution to a difficult problem: Sinclair's delivery schedules required maximum pump station capacity 100 percent of the time on one of its lines. To cope with the fast changing pressure upsets which would occur near pipe-bursting limits, Sinclair needed a fast-acting, heavy-handed control system that would allow virtually no pressure overshoot. In fact, Sinclair engineers arbitrarily limited overshoot to five psi beyond the normal set-point levels.

Sinclair circulated the specifications of the control system it desired among a number of suppliers, and invited them to test their control systems at Sinclair's products pump station at Copan, Okla. Seven companies responded—three with electronic systems, three with pneumatic systems and one with a hydraulic control system.

The latter excelled in most respects. Here are some of its outstanding features:

1. The hydraulic signal pressure control system is fast and stable. Pressure changes in the magnitude of 100 psi per second were handled with less than 5 psi overshoot.
2. Signal lag and wind-up do not exist. The only lag involved is the stroking time of the valve.
3. The controller is designed for outside installation; connecting piping is very short.
4. The valve action is fast.
5. The system is simple and easily adjusted by ordinary pipe line personnel. (No electronics involved.)
6. If pressure overshoot can be limited to five pounds, the pressure gap between the set-point and shut-down limits can be decreased from 40-50 psi to 10-15 psi and this 30-35 psi can be used for pumping.

By organizing the competitive tests, Sinclair gained two advantages: First, the company acquired a pressure control system capable of handling a tough problem, and second, Sinclair personnel gained a considerable knowledge in the field of dynamic pressure control.

Also, the controls manufacturers, regardless of their standing in the test program results, learned a great deal about the operating characteristics problems of every-day pipe line operations. The test results clearly indicated that some of them did not understand the problems that exist in a "tight-line" operation.

Sinclair should be congratulated for organizing the test program along scientific lines so that definite characteristics of throttling valve control systems could be set down as numbers and quantities rather than intangible guesses and opinions. Pipeliners with other companies would do well to become more familiar with the advantages of this sensitive, fast-acting control system. Also, pipeliners should encourage control system manufacturers to direct more of their engineering talent and research toward control systems specifically for modern system pipe lines, and refuse if necessary, to adapt general purpose control systems to pipe line requirements.

ALTERNATE PRESSURE TELEMETERING

The telemetering technique described here is not all new. It is novel in some respects and has some definite advantages over most methods now used for remote supervision of pipe line systems.

In order to efficiently control a pump station, it is necessary to know suction, discharge and station differential pressures. For several years Platte dispatchers have been observing recorded station suction pressures, called for outgoing line pressures, mentally comparing the two and making the necessary decisions to add or reduce pumping power, shift the system pressure pattern, shift the electrical load to stations with lower cost power, etc. One of the difficult and costly aspects of this system is to maintain reliable operation and absolute calibration accuracy of two telemetering transmitters, two telemetering communications circuits, and two receivers per pump station. But if the suction and outgoing line pressures are alternately telemetered from one transmitter over one circuit to one receiver, the maintenance is halved and at least two intrinsic advantages are realized as a bonus.

One of these is differential pressure accuracy, for by using the same transmitter, receiver and circuit to measure two pressures alternately; the absolute calibration and chart reading inaccuracies cancel. The station differential pressure as read from the chart is more accurate than either the suction or the outgoing line pressure, as it should be.

The other advantage becomes obvious when a station chart is examined. The alternate trace actually shades the chart and pictorially presents a performance record to be compared with optimum conditions. By quick across-the-room examination of a large number of charts, the dispatcher can readily determine the existing pressure pattern, trend of the change if any, and excessive throttling at any station is immediately evident and measurable.

The equipment needed to alternately connect the station telemetering transmitter directly to the suction and outgoing line pressure take-off-points is quite simple and relatively inexpensive. A repeat cycle timer with adjustable "on" and "off" cams controls a miniature three-way valve which selects suction pressure for a certain time period, purges the instrument piping during the valve transition period, then selects outgoing line pressure for

An Area Station Maintainer Should

SINCERE INTEREST

HIGH LEVEL OF MECHANICAL ABILITY

KNOWLEDGE OF FUNDAMENTALS OF ELECTRICITY

the remaining time as determined by the timer cam settings.

When Platte first attempted to develop this technique, a suitable valve for the job was not readily available but a major manufacturer of miniature valves and actuators now has the combination listed as a catalog item.

The technique of alternate telemetering, including the advantages to the dispatchers and to the maintenance technicians, is so appealing to Platte that a complete changeover to this principle is in process at this very moment.

THE AREA STATION MAINTAINER

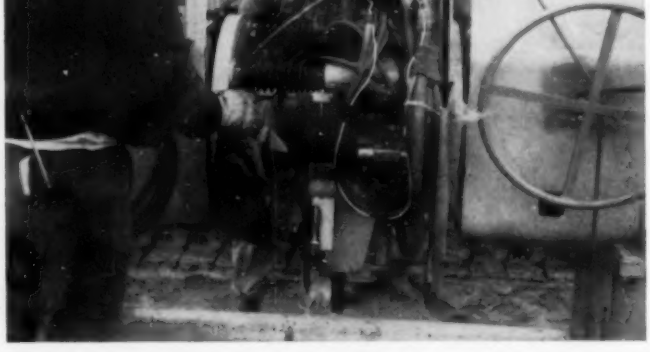
Several years ago, Platte and many other companies started installing remote control facilities and extra protection equipment to fully attended pump stations. After an equipment shakedown period, part or all of the station operating staff was removed from the station. More than likely, the unattended station was then visited every week or so by some one from an adjacent fully manned station, by the mechanic, the electrician, and probably others, but as more and more stations were converted to remote control, it was obvious that other arrangements would have to be made for station maintenance. It was at this stage that the job of station maintainer was created.

Qualifications for an Area Station Maintainer. Probably one of the most important qualifications for a maintainer is interest—interest in each item of equipment and interest in making automation work. Ability or even excellence as a mechanic, electrician, instrument technician or station operator is not enough. The man must have a sincere interest first. Maintenance ability will follow with good instruction and experience.

To list all the qualifications of a good area maintainer would be difficult indeed, but here are the general qualifications.

- **Operator**—He must thoroughly understand all types of pump station operation—manual, local, automatic, and remote control. He must understand how each station is related to the system, and detail, how all equipment in the station operates, either as a unit or as part of the entire station complex. A good maintainer is a good station operator.
- **Mechanic**—He must possess a high level of mechanical ability. He doesn't have to be a craftsman but he

After pipe ends are butted square a cutting wheel grinds out a 1/16-inch gap around 180 degrees of pipe arc. Cut runs from 12 o'clock to 6 o'clock.



Welding progresses downhill filling in the slit just cut in pipe ends. An internal line-up clamp keeps joints securely aligned. On 6-inch, welds were completed in less than a minute.

Possess These Qualities

ABILITY TO DETECT AND ISOLATE TROUBLE

BE GOOD REPORT WRITER

will have to know how to maintain motors, pumps, valves, and other mechanical devices.

• **Electrician**—He must have a knowledge of the fundamentals of electricity adequate to enable him to disconnect and connect electrical devices, make simple repairs, use ordinary test equipment required to trace wiring, detect opens and grounds, and use the tools of an electrician.

• **Instruments**—He must know how each instrument in his station is connected to the measured variable, how it works, what it records, how it is calibrated, and how to replace or repair it. If the instrument is faulty, he must be able to describe the trouble to a technician in the proper technical language and follow specific directions in the repairs.

• **Trouble Shooter**—He must develop the ability of detecting and isolating trouble quickly and accurately. It may be necessary and possible to isolate a piece of faulty equipment and keep the rest of the station in operation until a mechanical or electrical technician arrives to make major repairs. A good maintainer must be resourceful in this instance.

• **Report Writer**—He must be able to write good reports and keep a complete log of his maintenance activities. A detailed maintenance log written in a methodical manner is often vitally important to technicians who visit the station on maintenance calls when the maintainer is not present.

• **Student**—A good maintainer studies constantly to improve his knowledge. In order to reach a complete understanding of how each piece of equipment works and how it is related to station operation, he must study instruction books thoroughly and fortify his study with actual experience, or drilling, in maintenance so when the time comes for a major repair, he is thoroughly qualified to assist.

• **Supervisor**—A good maintainer must develop the ability to be a good supervisor. Since he must work alone most of the time, he must be able to supervise himself which is considerably more difficult than supervising others. This qualification is probably hardest to determine before selection for the job, yet one of the most important to the man's ultimate success in the job.

The point is this—we can conceive the most advanced design of pumping stations, we can buy the best equipment possible, we can install complicated interior control systems, we can even add protection equipment to protection equipment, but no matter how well individual pieces of equipment are made, they are still subject to failure and they can't maintain themselves.

This is where the maintainer concept of maintenance procedures comes into prominence. One man, highly mobile, well-trained in all kinds of maintenance, can perform routine maintenance tasks and intelligently determine and report the condition of several stations. Through his initiative and developed abilities, the entire pipe line system will benefit and highly trained specialists are thus freed from routine maintenance tasks to devote their skill and energy to major repairs and adjustments.

AUTOMATIC WELDING

Automatic over-the-ditch welding moved closer to reality during 1960. Pipe line construction and welding experts have been researching into the problems and developing the equipment for several years. Their labors are now being reflected in ingenious new machines, two of which are described here.

Automatic Shielded Arc Welding Process. Esso Research and Engineering Company of Linden, N. J., has recently released information relative to a new automatic pipe welding device which may well revolutionize field pipe line welding as it is known today.

Esso Research developed the process with assistance from the Battelle Memorial Institute of Columbus, Ohio, Air Reduction Sales Company of Union, N. J., Crutcher-Rolfs-Cummings Company of Houston, and Bauer Associates of Calgary, Alta., Canada. A prototype machine was recently tested under actual field conditions on a Humble Pipe Line Company project and all reports indicate that it did an outstanding job on a mile of 6-inch X-46 pipe. (See March PIPE LINE INDUSTRY, Page 26.)

Induction Heating-Pressure Welding Process. The Petroleum Equipment Branch of the United States Army Engineer Research and Development Laboratories at Ft. Belvoir, Va., is busily engaged in the development of an induction-heating pressure-welding process. C. W. Karstens, chief of the Petroleum Equipment Branch, reports that the project, which his colleague Taylor Jefferson has supervised as project engineer since its inception in 1956, is now developed to the point that they are making consistently good laboratory welds. The next phase of the project will involve actual field welding conditions.

The goal of the project is to develop the equipment and techniques which will ultimately yield high production rates with a minimum of personnel and logistical

Continued on Page 55

A Digest: Manning for Tomorrow's Operations Today

Here's an exciting description of the challenges we must meet in the years ahead

By Jack A. Horner, President,
Shell Pipe Line Corp., Houston

THE PIPE LINE INDUSTRY faces new challenges and responsibilities for the entire oil industry is moving into an era where earnings will not come as easily as in the past. Demand is no longer growing as fast as it was. Growth in the use of domestic crude has been virtually at a standstill for the past few years. The market for liquid fuels is expected to grow more slowly in the future.

Costs Have Continued to Increase. Apparently wages, salaries and benefits have increased considerably faster than productivity and the rate of return on investment in the oil business is declining. The maneuvering room between income and outgo has become narrower.

All Kinds of Competition Have Increased. Competition between natural gas and fuel oil for the home heating business; competition among oil companies for the automotive gasoline market; competition between oil, coal and gas for the utilities business and heavy industry, and competition with crude and products brought in from abroad.

And these things seem to be here to stay. We can expect continued growth but probably not the kind that has allowed for the relatively easy progress of the past. Future achievements in science will surely lead to new products and to opportunities for new growth. But this kind of thing takes time, and prudent management cannot wait. It must consider ways of improving its picture now!

Manpower Must Be Used Better. In the field of personnel we are not making the best use of what we've got. As individuals, few of us come anywhere near performing at full capacity. Even in well-organized groups we may not do much better. It would seem worthwhile to try to help each individual realize more of his potential and to help groups work more effectively.

This is not meant as criticism of past performance. The pipe line industry has a tremendous record. What I suggest is that we consider changes to meet changing times. Progress in technology has revolutionized the whole atmosphere in which we work, the functions we can perform and the responsibilities we must, therefore, assume. The same technology that multiplies our power to produce puts on us the burden of enlarging our ability to use the power and use it wisely. We must hurry to catch up with the new instruments and techniques that have come to hand.

The trend in the pipe line industry is toward fewer jobs, but more productive jobs, therefore more demanding jobs—jobs that require men with more training.

When we think about personnel we think first of our present employes. This should be. It flows naturally from management's sense of responsibility and is implemented by seniority rights in labor contracts or by custom. So our first step should be to evaluate existing staff in the light of requirements for tomorrow's operations. This evaluation must be on the basis of quantity as well as quality.

This is no small undertaking. Standards must be established, job specifications prescribed, aptitudes judged, operating manuals prepared and an appraisal made in many cases of the ability of nontechnically trained personnel to achieve semitechnical skills. Likewise there is the requirement to establish our manpower needs 1-5 and even 10 years ahead. This we must decide in the light of our plans for automation, contract maintenance and our prospects for growth.

Having established the required skills and optimum manpower level, there will inevitably be the necessity to upgrade a significant segment of our personnel—technical, administrative, management and hourly paid. All training techniques in the arsenal of the personnel department will be needed if we are to achieve our objectives.

Certain requirements stand out in this field of training and development. Every employe is entitled to be informed, frankly and fairly, of management's appraisal

of his performance and career potential and what will be expected of him to meet the demands of the future. Where formal training is required, co-operation between supervisor and employe must be achieved, for only with this can complete, well-rounded training be provided. A selling job may be required so the employes will recognize the needs and aspire to the rewards.

In staff evaluation, cases of inadequate performance will inevitably be encountered which we must face up to. We believe that advances in personnel techniques enable us now to tell in the first 6 or 12 months of a man's career whether he is the kind of employe we want for the long pull, but unfortunately this has not been the case in the past. As a result, we may be called upon to make some very hard decisions.

Staff Complement for Future Operations. Fortunately, for the pipe line industry, automation has been sufficiently evolutionary for attrition to take care of a good share of our problems. Unfortunately, it has not been the answer in every case, and management has faced a familiar problem of effecting severance with a minimum of pain and suffering. Severance payments, early pensions, employment aid and other assistance has helped, but despite these, the results are usually somewhat unpleasant to both management and the employe.

For the more and more exacting jobs we can see ahead in the pipe line industry, recruiting of formally trained personnel probably is a major answer. And here we will have to compete with such glamorous things as electronics and space vehicles. Still we have a great deal to offer, and we should offer it attractively.

Future Personnel Requirements. Station operating functions are today being performed remotely, or by local automatic controls, and the old three-shift station operator's job has all but disappeared, and men holding these jobs must be reassigned. But this leaves us with what in many respects is a more critical job to fill: the attendant at a modern automatic station. He requires considerable technical aptitude and sufficient skill to perform preventive and regular operating maintenance.

Increasing the capabilities of our mechanical, electrical and communications craftsmen is a definite must:

- The majority of our mechanical work today requires considerable precision; mechanical seals and controls involve tolerances bordering on those used by a watchmaker.

- The electrical craftsman, like our professional engineer, must constantly study to be qualified for servicing new equipment that has come with the introduction of supervisory controls and electronic gear.

- In communications, the wire line technicians are rapidly being replaced by microwave technicians. Here again, personnel who can learn and apply new skills are required for today's operations, requires an especially high reliability of communications, and this depends in a large measure on the abilities of our communications technicians.

The growing tendency toward contracting of routine maintenance is also imposing supervisory responsibility on our craftsmen and technicians. Not only must they be skilled in their craft field, but they must be capable of directing contractors.

Pipe line maintenance has also changed and will continue to do so. We will continue to reduce the number and size of maintenance crews because of fewer leaks, improved transportation, chemical control of right of way vegetation and less requirement for station relief.

We must also bear in mind that maintenance crew personnel must be selected with an eye for technical aptitude if they are to move into station attendant, technician and oil measuring jobs.

Our dispatchers have already witnessed many changes in their business, but more are in store for them. Some of the more obvious developments in this field which are already, or will soon be commonplace are:

1. The use of computers to establish proper inventory levels and to determine optimum line operating conditions.

2. More precise blending of crude and products.

3. Better control of volatile injection to keep streams within predetermined vapor pressure limits.

4. Remote and local automatic control of stations.

We can anticipate one day turning the job of scheduling, dispatching and line operation over to the computer, but until we lick the economics of such an operation we must see that our schedulers and dispatchers take advantage of all possible economies and efficiencies and continue to satisfy our shippers increased requirements.

We are confident that field automatic custody transfer will find increasing application. This will mean that our gaging personnel must develop additional skills. They must recognize measurement errors in the automatic equipment, be able to make exacting calculations in determining meter factors, and analyze system operations to insure minimum oil losses with even fewer measurement check points.

At our terminals and tank farms, meters, remote gages and complicated blending operations will all demand more skills than have been required in the past.

The operations supervisor will likewise require greater technical knowledge. Although the personnel supervised will be fewer in number, they will be more highly skilled and our supervisors must develop administrative and supervisory techniques to meet these new conditions.

Scientific and Engineering Staff. The shortage of competent engineers is not likely to ease and the competition from other and perhaps more glamorous industries will continue. Proper manpower planning and development in this area of our business is the key to whether any substantial organization can expect to survive and grow in the atmosphere of dynamic technological changes. We must continue to examine carefully our present organization and to improve its climate so that our existing engineering staff will improve its performance and efficiency.

Technical personnel should be challenged to develop their ultimate potential. Technological pioneering and inventing must be made easier. The uninhibited "wood-

About the Author

Jack A. Horner, president of Shell Pipe Line Corp., received degrees in law and in arts and science from Oklahoma University. He started with Shell Oil Co. in Tulsa in 1936 in the Legal Department and was later transferred to Illinois and New York. In 1944 he was appointed to the group which planned the company's postwar organization and expansion. He became administrative assistant in the office of the president of Shell Oil in 1945, and four years later he was named assistant secretary of the company. He became secretary in 1953. Two years later he became vice president in charge of the licensing division of Shell and in January 1960 he became president of Shell Pipe Line Corp.

shed" inventor and idea man, even though he may not fit into our preconceived picture of the organization man, should not be discouraged.

Engineers must not be saddled with clerical and drafting chores or if a so-called engineer is capable only of performing such chores, he must be reclassified. Direct and free lines of intracompany communications for disseminating technical knowledge, new ideas and problem solutions are important and must be strengthened. Active participation in technical societies and professional recognition through published reports is an excellent climate generator. Young engineers need to obtain a sense of recognition and achievement by being assigned to special, short-term, productive studies.

Field technical staff should be sized to handle problems within their geographic unit—except those requiring an expert with specialized knowledge or experience in a particular field. These specialized technical people in various phases of engineering will be carried on central office staff and free to service all activities in which a need exists. We anticipate that more and more detailed design and drafting work will be accomplished by contractors with company personnel providing the preliminary studies and general specifications.

Of equal importance to the problem of creating a good climate for growth within our existing staff is the selection of new scientists and engineers. We must attract the most capable individuals and make available to them not only operational engineering jobs, but also specialist jobs requiring special attributes in certain fields. Management opportunities should be open to those with the necessary skills and desires. The emphasis will be on quality—not quantity.

The Financial and Statistical Branches of Our Business Cannot Be Overlooked. What kind of financial people do we need to fully benefit from the enormous opportunity and expense of computers and related equipment? What kind must we employ, and what training must they have to integrate data processing and assure mechanization's economic usefulness as a valuable management tool?

Certainly, many of the old requirements still remain. We must have people with a fundamental knowledge of accounting who can think for themselves; who are energetic and imaginative. These have always been among our requirements. But we must find more thinkers—people who are not afraid to think—who, in fact, will be afraid NOT to think. Security and idleness of mind have too often been permitted to feed on each other.

We also need people who can direct their thoughts along definite avenues; who can analyze and pick at problems from all sides; who can separate the parts and understand their relation to each other and the whole; who can get to the bottom of problems instead of shadow-boxing with them, and then find solutions tempered with judgment, and economy, and a dozen other things. Thus, the analytical mind is a basic requirement. But probably most important, financial people must have the ability to inform and report in convincing language which can be understood by management.

For it is mandatory that operations personnel at all levels be fully informed of the costs of their operations. Further, they must be able to analyze these costs and to justify them when necessary. This presents a twofold challenge to the financial people—they must present operating costs in a usable form and assist in training the operations personnel to interpret them.

So we need people who, along with normal everyday requisites, are energetic thinkers, analytical in their approach and concept and able to communicate their thoughts to others.

We, in industry, should take a careful look at ourselves. We seek individualism instead of conformity; but too often, it seems in practice we encourage the latter. Too often, thoughts dissimilar to our own are discarded before they get a chance to breathe. Too often, we do not test an individual's capacity until erosion has set in.

If we are to utilize the maximum abilities of tomorrow's employes, we must challenge them! On-the-job training experience should include assignments in methods and procedures, organization studies and data processing. Every man should be a "methods" man with a working knowledge of machinery. To keep up to date on the latest data processing hardware and procedures, we should take advantage of programs offered by equipment suppliers and universities. To provide special training for particular jobs, it will probably be necessary for new employes to participate in more job-oriented seminars and company-sponsored schools.

Most difficult of all to appraise are the requirements for our future management group. It does not seem likely that top management will change much in size. As for the intermediate echelons, we might expect some contraction, just as we do in the staff and operating phases, as improved techniques and equipment permit greater productivity.

But the essential management function remains—directing the show. If it is to be done intelligently, the manager must know where he has been (he needs experience); he must know where he is (he needs information and alertness and sensitivity), and he must know where he wants to go and have a pretty good idea of how to get there (he needs judgment and resolution). He must get other people to do whatever is necessary, to do it as well as necessary, and to do it on time.

Where Do We Get Managers? At Shell we believe in home-grown management, and we tend the garden care-

fully. We never take it for granted we will get the new management we need through the trickle-up process.

We run a continuing program of review. Everybody in the organization knows that the opportunity is there for everybody. We start watching men early, but we make provisions for the late starter, the man who makes it through hard work, because, in fairness to this man and in the interest of the company, he should be considered for management development even though he may not have been identified as potential management material early in the game.

In finding new men for management, the easy part is determining the man's knowledge of particular subjects with which he is to deal and his ability as demonstrated through past performance. It is not quite so easy to gage his potential as indicated by observation, analyses, tests and interviews. These might all come out quite high in a man who would make less than an outstanding manager; for beyond these lie integrity, strength of character, ability to generate enthusiasm in others, to command respect and loyalty, to judge others, to assess information, select what is pertinent and to decide calmly.

And how can we help managers become more efficient? By giving them the information they need in order to make good decisions. This means, among other things, electronic computers. They can provide more information than management has ever had, and they can provide it faster and in more useful forms. They can even indicate solutions to certain types of problems. They are valuable tools.

But let's not be too quick to hand the keys to the shop over to some U-shaped monster with a four digit name and go fishing. These things are meant to help management, not manage. There is room for cool questioning about exactly how far these things can go in giving human managers an excuse for sidestepping the responsibility for decision. Indeed, they may do some of their best work in helping to keep managers on their toes.

Besides new equipment, tomorrow's management will also have the chance to use new techniques. The alert management group will not overlook such opportunities as these offered by the advanced training courses at some of our great universities, and the technique some call "Operations Research" in which entire industrial operations are conceived in total as economic processes and subjected to the mental processes and methodologies associated with the research work of the physicist, the chemist and the biologist.

Manning for Tomorrow's Operations Today. What does it come down to? Getting new knowledge, devising new approaches so as to solve new problems and thus achieve new levels of efficiency. And yet, is it really new? Is it revolutionary? No. There is nothing in any of this to be alarmed about, and probably nothing to justify public holidays and festivals of rejoicing. What we face is a continuation, perhaps with some hastening, of what has been going on since the start of the industrial revolution.

ACKNOWLEDGMENT

From a paper presented at the Annual Pipe Line Conference of the API's Division of Transportation, April 26-28, 1961, St. Louis, Mo.

New Developments in Crude and Products

Continued from Page 51

support. They ultimately hope to add a 60-foot joint of 8-inch pipe every two minutes which will allow them to build pipe lines at the rate of one mile every three hours in any kind of weather over virtually any kind of terrain.

Fabrication of the experimental unit was accomplished by the Swift Ohio Company of Kenton, Ohio, and delivery of the prototype model was made in October 1959. The development project was temporarily terminated in January 1960 for budgetary reasons but, since that time, a number of demonstrations have been conducted, one of which was attended by a number of representatives from the petroleum industry.

The unique feature of this welding process is that no rod and no flux are needed. The mechanical preparation consists of an end milling process to assure uniform peripheral contact and an expanding process which assures that the pipe ends to be joined are perfectly concentric. After the preparatory mechanical process is completed, the two pipe ends are pressed together with a force of about 2,900 pounds per square inch and then the induction heating ring moves to a position over the joint. The induction coil couples about 100 kilowatts of three kilocycle power into the area of the joint, producing a temperature of 2600° F. After the joint is heated for about 25 seconds, the hydraulic ram applies approximately 500 tons forging pressure to complete the weld. The total elapsed time for the process from line-up to completed weld is 90 seconds. The resulting weld has no internal upset and only a small bulge on the pipe exterior.

Mr. Karstens reported that a formal engineering report has been started but the publishing date has not been set. The laboratory wants to cover the project with a comprehensive paper sometime soon and show some films of the welder in action. From the information received to date on this project, it appears that a paper on this project would be of intense interest to the pipe line industry.

ACKNOWLEDGMENT

From an original paper presented at the Annual Pipe Line Conference of the API's Division of Transportation, St. Louis, Mo., April 26-28, 1961.

About the Author

Fred S. Jones is chief engineer of Platte Pipe Line Company, Kansas City, Mo. After a tour of duty with the U.S. Marines, he was graduated from the University of Kansas in 1949 with a degree in electrical engineering. After two years as a design and development engineer, he joined Platte in 1952. He has worked as a microwave technician, communications engineer, electrical engineer and superintendent of engineering and communications. He was instrumental in development and construction of Platte's vast communications and remotely controlled system. Jones is secretary of the Petroleum Industry Electrical Association and a member of the Institute of Radio Engineers. He is an associate member of AIEE.

Designing and Using Offshore Tanker Moorings

This subject is becoming more and more important in today's pipe line economics

By Robert P. Howell, Supervisor of
Electrical and Mechnical Division, Engineering
Standard Oil Co. of California

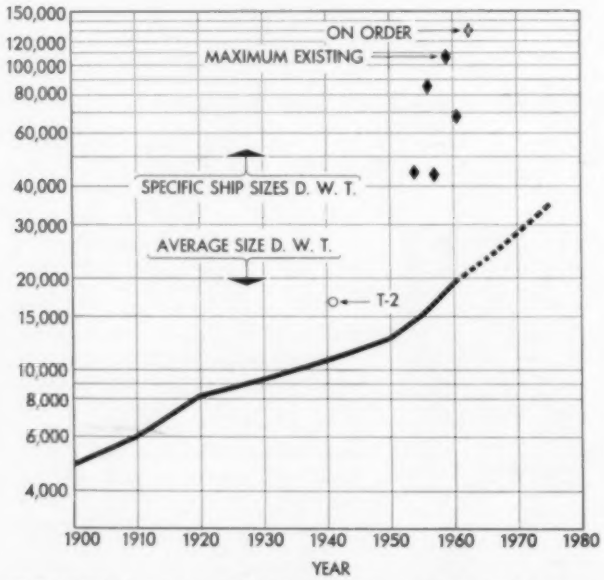
OFFSHORE MOORINGS have been used for many years; but in recent years, they have become much more attractive to industry because of the increasing size of tankers. Figures 1 and 2 show the trends in tanker sizes and the projected drafts which will be necessary for handling them.

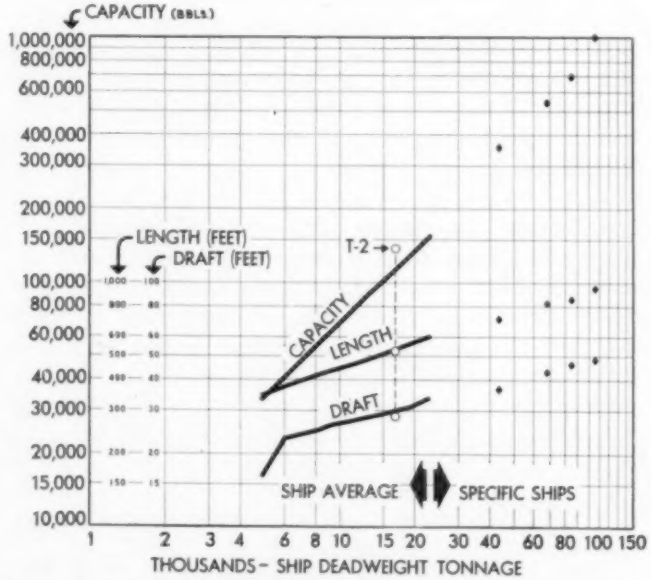
Types of Offshore Moorings. There are four types of moorings in use today. They are: *Submarine Line Sea Terminals, Fixed Berths, Hose Handling Platforms and Mono-Moorings.*

SUBMARINE LINE SEA TERMINALS

Layout and Design. This is the simplest type of offshore mooring. Schematic drawings of such moorings are shown in Figures 3 and 4.

Just how does a vessel get into such a terminal? From the illustrations you will see that the desired objective is to have the ship centered in the moorings, with lines out aft and on each side to permanently anchored buoys. The ship's two anchors hold the bow in place and she is heading out to sea while discharging or loading. Crude is discharged to the refinery through the hose on the starboard side and the submarine pipe line. To get into this posi-





FIGURES 1 and 2—TANKER SIZE. Actual and forecast. RELATION of deadweight tonnage, capacity, length and draft.

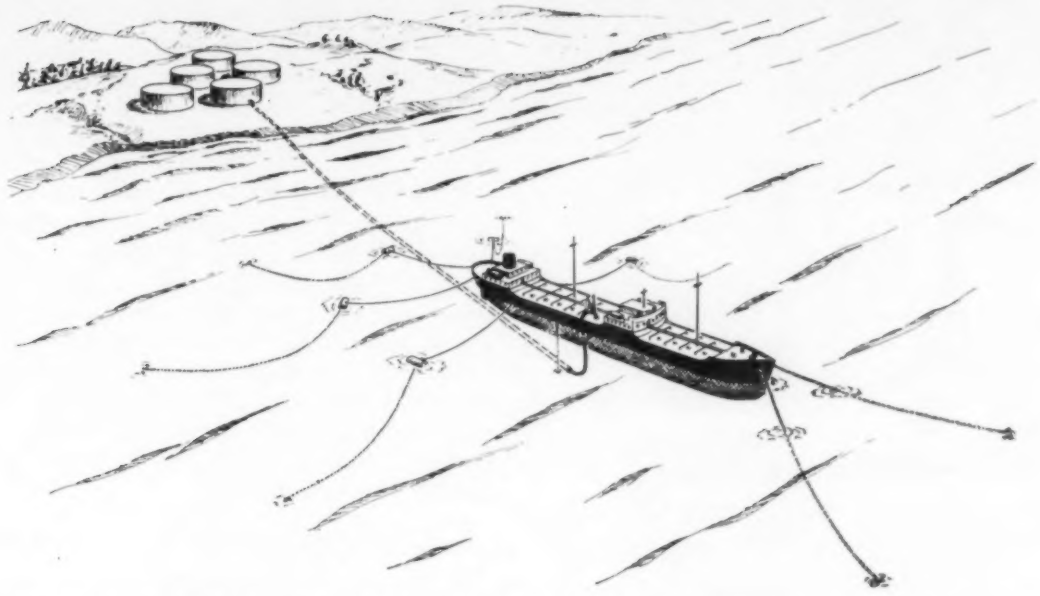


FIGURE 3—SUBMARINE LINE SEA TERMINAL using a 5-buoy layout—two on each side with one aft. Anchors hold bow.

tion, the tanker performs a "running moor." The vessel comes along slowly outside the moorings and at right angles to her final position. She drops one anchor as she approaches and then proceeds slowly across the mooring area to drop the second anchor. With the bow controlled by these anchors, the ship's pilot backs her slowly into the moorings. A launch then takes rope or wire lines from the tanker to the buoys.

Special Requirements of Sea Terminals. To be suitable for an offshore sea terminal, a location must meet certain requirements:

1. The water must be relatively shallow over a large maneuvering area. The actual depth needed will be determined by the size of the vessel using the moorings.
2. Currents, if present, must be moderate and steady. Sudden changes in direction are undesirable.
3. Winds should preferably blow consistently from one direction.
4. If severe swells occur, is should be possible for the ship to head into them.
5. The bottom must provide good "holding-ground" for ships' anchors.

Hose Handling at Sea Terminals. Most sea terminals use submarine hoses with the general arrangement shown in Figure 3. However, the method has two limitations: 1. Only two or three hoses can be used without bringing up the problem of keeping individual hoses separated, and 2. Hose size is generally limited to 10 and 12-inch. But even the latter can restrict high-rate flow. There are 16-inch hoses, but they are too heavy for most tanker's gear.

Floating hoses are suitable when the vessels can be brought close to shore or to a pier where the hose can be stored between tanker arrivals. A new method for handling submarine hoses is the "Hartley Hoister," Figure 5. This device is intended to eliminate flow restrictions by using multiple hoses and to reduce hose-handling time.

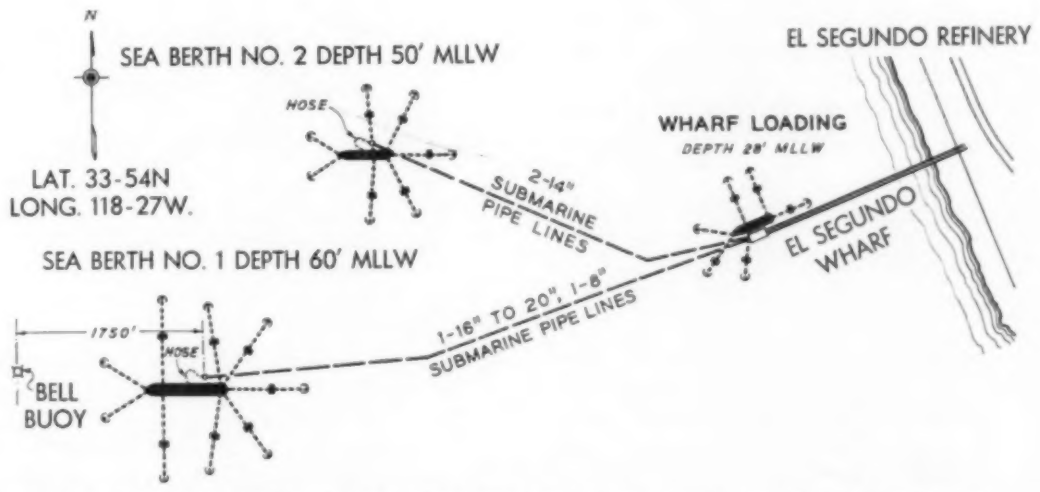


FIGURE 4—NEW AND OLD SEA TERMINALS off El Segundo. New Berth will handle new supertankers.

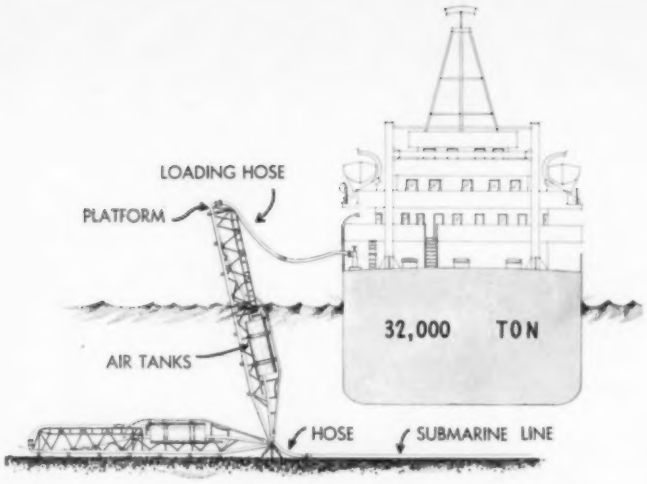


FIGURE 5—HOISTER. For details see Feb. 1960 PIPE LINE INDUSTRY, page 59.

After an experimental model first used at Kuwait, the only reported installation is by Stanvac in the Philippines. Here it was believed that conventional submarine hoses would sink through the soft mud and be difficult to lift. (See PIPE LINE INDUSTRY, Feb. 1960 p. 59.)

Advantages of Sea Terminals can be summarized as follows:

1. Low investment cost of mooring facilities.
2. Suitable for the largest vessels built or contemplated.
3. Ship enters and leaves terminal under own power, without tugs. Only moderate-sized mooring launches required.
4. Suitable for installation at isolated locations. Minimum amount of construction material and equipment required.
5. Rapid construction possible.

Disadvantages of Sea Terminals are as follows:

1. They are usually not suited to handling multiple products.
2. Dry cargo and ships' stores cannot be conveniently handled. Fresh water cannot easily be supplied.
3. Bunkering may not be possible, or cost of bunkering facilities and a separate submarine line may be prohibitive.
4. Entire crews cannot have "liberty" ashore. The ship must be adequately manned and in sailing condition at all times.
5. Large area occupied by buoys, and more needed by tanker for maneuvering, may not be available or may conflict with other shipping in the area.
6. In remote locations, buoy and chain maintenance may be expensive.
7. Continuous launch service is needed to ensure that the vessel may leave the moorings at any time should weather or sea conditions require.

FIXED BERTHS

The fixed berth is a substantial structure, often consisting of several platforms connected by walkways. The platforms are supported by steel or concrete piles, or by caissons or sheet piling with rock fill.

An example is Richmond Exploration Company's sea island structure in Lake Maracaibo, Venezuela, Figure 6. Heavy, heated Boscan crude oil and hot asphalt are delivered to the island through submarine lines. Tankers, from T-2 in size to 45,000 dwt, load crude and asphalt.

A very large 5-platform island structure is being constructed by Basrah Petroleum Company south of the Iraq oil port of Fao. This terminal will handle tankers of the largest size afloat and will be served by two 32-inch submarine pipe lines. A structure of this type must be designed to withstand the impact of a tanker during a less-than-perfect berthing. It is also subject to the pounding of a ship moored to it in an exposed location. An adequate fendering system can minimize damage to either the structure or ship.

HOSE-HANDLING PLATFORMS

Another solution to mooring a tanker in open water is to combine some features of the submarine line sea terminal with a small structure on which to end the pipe lines and provide facilities for cargo hoses. An example of such a terminal is that installed by Mobil Oil Company of Venezuela at El Palito, Venezuela. Figure 7 shows the arrangement of this terminal. Although the designers chose a causeway and trestle for the pipe line approach, the structure and mooring arrangements would be applicable to an open-sea location.

The basic concepts of such a design are:

1. The tanker comes in without assistance by tugs.
2. Mooring is accomplished by the ship's anchors and lines to buoys, as in a sea terminal.
3. The pile fendering system serves primarily to keep the ship away from the platform. The fenders are not subjected to anything like the full force of the ship, since the mooring lines to buoys and the ship's anchors provide basic control of the vessel.

Hose Handling Methods. The usual solution is a mast or boom by which the hoses can be lifted, usually with some type of small winch. Some recent installations have used hose-handling derricks; Figure 8 is an illustration.

Hose-handling derricks and the hydraulic loading arm permit rapid connection to the ship and also provide for ship movement. None of the designs so far developed are entirely satisfactory, and many engineers are attempting to develop better means of handling hoses.

"MONO-MOORINGS"

It should be apparent that offshore moorings of the types discussed have a number of drawbacks. Some engineers and marine people have been working on an "ideal" solution to these problems: Install a "point" mooring, hold the vessel to it by the bow and let the vessel swing free to weather or current while loading or discharging. This would be the so-called "mono-mooring." It has proved to be as difficult in execution as it is simple in concept.

The problem has been how to combine the necessary features of a permanent bow-anchoring buoy with practical means for handling hoses suitable for high flow rates —and all in perfect safety to tankers of tremendous size.

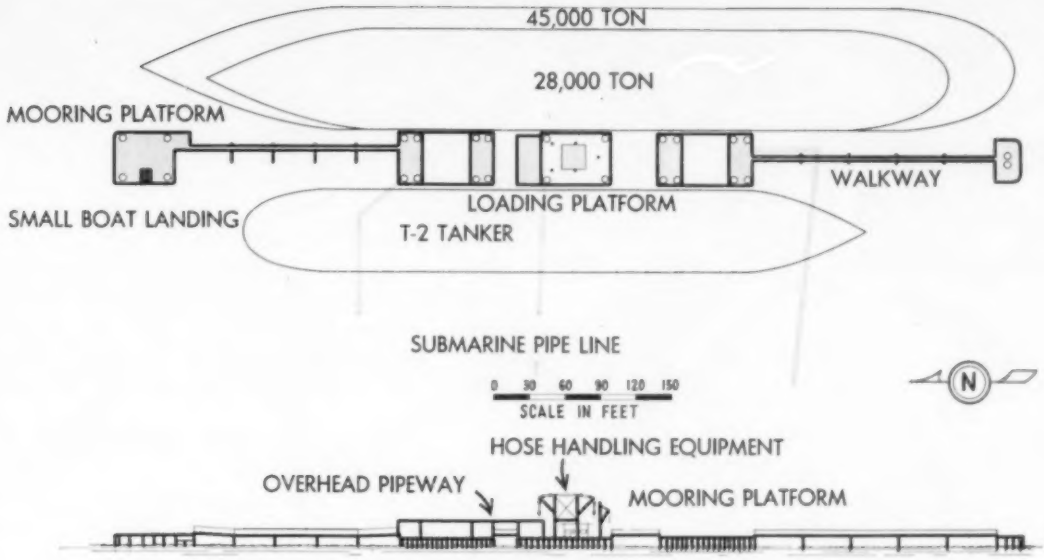


FIGURE 6—SEA ISLAND. Bajo Grande, Lake Maracaibo.

Briefly, here are some of the problems that must be solved in a successful mono-mooring:

1. The ship must moor to the buoy easily and safely. The ship's crew must be able to cast off, both as a routine operation and in an emergency, with no more than usual assistance from a mooring launch.
2. Connections to the mooring buoy must be "free-wheeling." The ship, with its mooring lines and hoses, must be free to swing completely around the buoy.
3. Satisfactory hoses and hose connections must be provided. For most tankers, this means that hoses will lead from the buoy along the side of the vessel to the piping manifold located amidships. Ultimately, hoses over the bow may be feasible, but few ships are now equipped for them.
4. The vessel must not range forward on the buoy under combinations of wind, sea, and swell. A light stern mooring would control this movement, but it would also prevent free rotation of the vessel.
5. Absolute assurance must be provided that oil leakage and contamination of waters cannot occur. This is particularly difficult to do and yet meet the "free-wheeling" requirement.
6. Costs must be competitive with a conventional multi-buoy sea terminal. A point to be noted, also, is that a mono-mooring would often be located farther seaward than a conventional buoy system to let a tanker approach it from any angle. This greater distance would incease the cost of submarine lines.
7. Facilities should be available for occasional maintenance or emergency repair of the buoy. This could be an important consideration. Although any component of a conventional multi-buoy sea terminal can be repaired or replaced, major damage to a mono-mooring buoy could put the terminal out of service for an extended period.

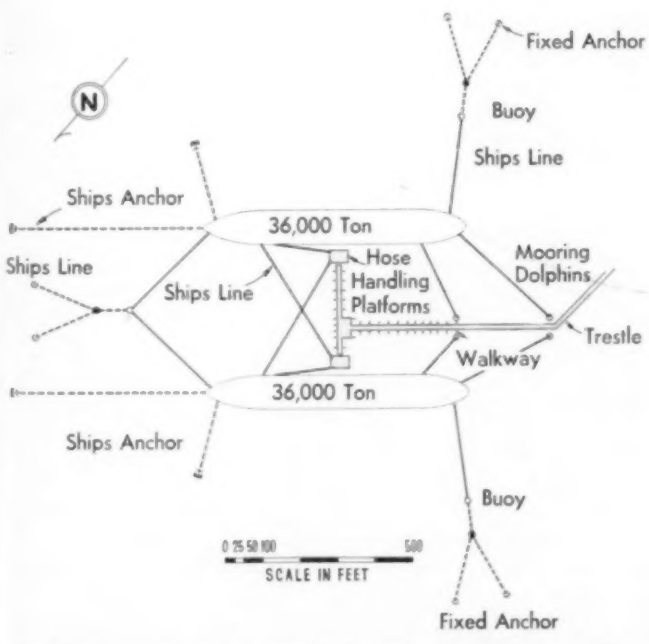


FIGURE 7—HOSE HANDLING PLATFORMS. El Palito, Venezuela.

Because of the advantages of a mono-mooring system, designs of this type have received attention from highly competent people in recent years. The firm now leading in this development is AB International Marine and Oil Development Corporation of Stockholm, Sweden. Several small "Imodco" buoys are in service, a large one was recently installed at Ravenna, Italy. A sketch of the buoy in service is shown in Figure 9.

SHIP HANDLING PROBLEMS

Water Depth. Most marine operators like to have a minimum of 10 feet of water under the ship in any type offshore mooring. This allows the ship maneuverability under its own power, and prevents damage from long swells.

Bottom Conditions. For any type offshore mooring it is desirable that the ship be able to use its anchors in maneuvering. The ideal bottom—sand or sandy clay—is relatively firm. Worst bottom is one too rocky for the anchor to penetrate.

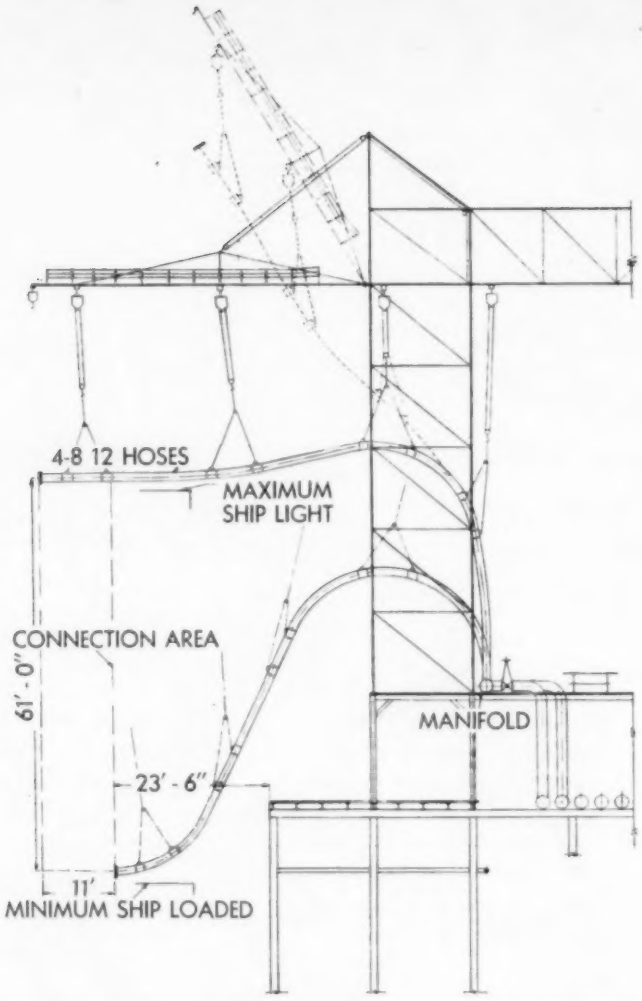


FIGURE 8—HOSE HANDLING DERRICK permits horizontal and vertical movement of ship.

Maneuvering Area. Most marine people like to have three to four ship lengths of navigable water between the moorings and dangerously shallow water. On the other hand, an extensive maneuvering area inside the moorings may not be essential where the terminal is laid out with its axis at right angles to the shoals and when the line of vessel approach is parallel with the line of shoal. A fixed structure does not require extensive maneuvering area.

Exposure and Weather Conditions. The heading of the ship in moorings is preferably such that the ship faces the open sea, and faces into normal winds and currents, and is in an advantageous position to leave unaided in an emergency. These requirements are not always met by any single arrangement.

Emergency Procedures. The most common emergency is a sudden storm that would cause the ship to exert excessive forces on the moorings, or on the ship itself. Self-releasing hooks on the mooring buoys, quick couplers on the hoses, and other devices are frequently used to permit a ship to leave its moorings quickly in an emergency.

Tugs. Offshore tanker moorings using sea terminals or hose-handling platforms will not usually require tugs to berth the vessels. Nevertheless, the first time a mooring is used, or if an exceptionally large vessel is scheduled to call, it may be worth-while to have a tug stand by if one is available. Normally, however, tugs will not be available at many offshore mooring locations. It is important that those responsible for the design keep this fact in mind.

Tugs are desirable at all fixed berthing structures, and *mooring launches* are needed at submarine line sea terminals and at any other moorings where ships' lines must be run to anchored buoys. The launches need not be large but they must be adequate to handle heavy manila or wire lines in reasonably rough weather. A typical launch would be perhaps 48 feet long, 13 feet in beam, and provided with an engine of at least 100 horsepower. The launch will normally stand by the vessel during her entire time in the moorings to be available in any emergency.

LOADING AND DISCHARGING

Economical Rates. With the larger tankers of recent years has come a corresponding increase in the rates at which they are loaded and discharged. The following table, adopted from John D. Rogers' presentation to the 1957 API Tanker Conference (3), indicates how one major tanker operator has increased vessel pumping capacity as ships have increased in size:

Vessel Size (dwt)	Nominal Capacity (bbl)	Total Installed Cargo Pump Capacity (bbl/hr)	Avg. Discharge Rate for Full Cargoes 30° API Crude (bbl/hr)
16,600	113,000	10,000	8,500
27,000	183,000	23,000	20,000
36,600	248,000	34,000	31,000
46,000	312,000	42,500	39,000

The usual practice is to design a terminal to load and discharge at the highest rate possible with the pumps and piping of the ships for which the terminal is planned. This is especially true with terminals having large throughputs, since a small amount of time saved on each of many ships visiting the terminal is an economic incentive toward higher rates. Also, multiple berths may sometimes be avoided if a single berth is used to its maximum capacity.

Single, Looped or Multiple Lines. When a terminal loads or discharges—but not both—a single pipe line is usually adequate. Separation can usually be achieved by slugs of water pumped from the ship.

A looped line is sometimes feasible. For example, at a

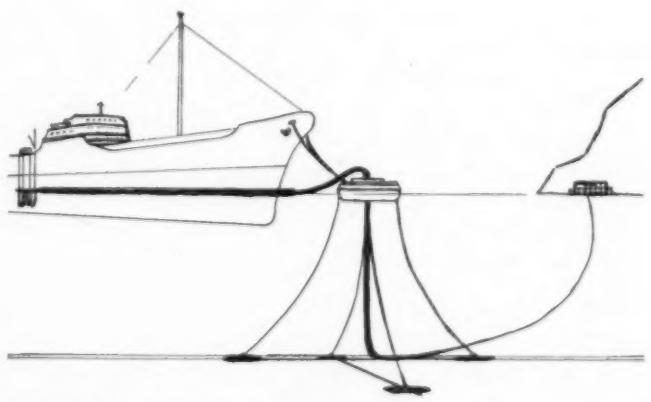


FIGURE 9—SINGLE POINT BUOY called "Imodco Buoy" permits ship to swing from one point at bow during loading operations.

refinery which receives and discharges a variety of cargoes. it may be desirable to prepare the line for the next scheduled vessel by circulating the previous cargo out, perhaps replacing it with "cutter" stock. A number of terminals handle both light and black oils and perhaps LPG. One set of moorings can be used for different ships handling these products if care is taken in arranging and marking the submarine hoses, etc.

Bunkering. If bunker fuel is available in the area, and if it is economical to bunker at that end of the run, it may be worth-while to provide a separate bunkering line and hose. An alternative is to bunker through a black oil submarine line after cargo handling has been completed. Here also, a circulating system will facilitate bunkering through the same line that handles the cargo. In an open sea terminal it will usually not be practicable to bunker the tanker from a barge alongside.

OIL MEASUREMENT

In most operations today tank gages are used for determination of tanker cargoes. At a major terminal much less tankage would be required if it were not necessary to allocate tanks to specific cargoes and provide certified tank gages for each movement.

The economical practice would be to measure all cargoes with in-line meters of large capacity and high accuracy. The pipe line industry is using both positive-displacement and turbine meters of increasingly large size for accounting purposes and custody transfer. Before long, we may expect that meters with capacities of 20,000 bph and greater will be available and accepted for all purposes of oil measurement.

DESIGN OF A MAJOR NEW SEA TERMINAL—SOCAL'S HAWIIAN REFINERY

So far, we have discussed general solutions to tanker mooring problems. Perhaps we can tie this material together by describing a new sea terminal which presented all the usual problems, plus others not often encountered, the submarine pipe line system and sea terminal of the new refinery of Standard Oil Company of California at Barbers Point, Oahu, Hawaii. (See January PLI page 33.)

Requirements. As the principal supply facility for this refinery, the submarine pipe lines and terminal must:

1. Moor the largest tankers now afloat or contemplated, as well as the common T-2 class of tankers.
2. Receive a variety of crudes from the East Indies, Saudi Arabia, Iran, and other sources. Some of these crudes are waxy, with high pour points; they must be heated for delivery through a submarine line.
3. Receive and ship heavy oils as fuel components or blending stocks. Some transfers with Socal's Pacific Coast refineries are expected.
4. Occasionally receive and ship clean specialty products.
5. Bunker tankers transporting crude to the refinery. The bunker fuels also require heating for efficient loading through a submarine line.

Location Problems. From the marine standpoint, a sea terminal in the Pacific Ocean off Barbers Point presented a number of unusual problems. First of all we had the

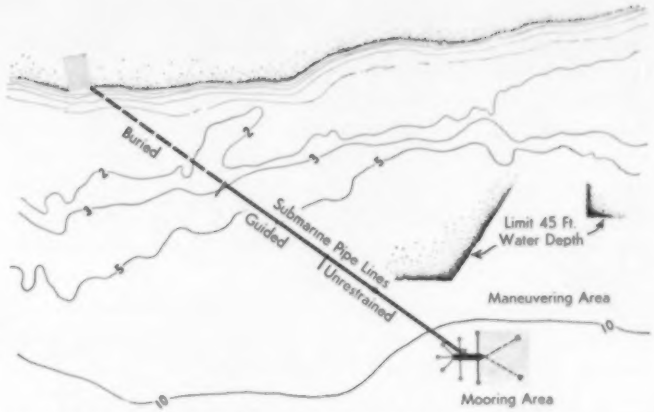


FIGURE 10—SEA TERMINAL AREA off Hawaiian Refinery. Water is 65 to 70 feet deep. (For details of submarine line, see Jan. PIPE LINE INDUSTRY, page 33).

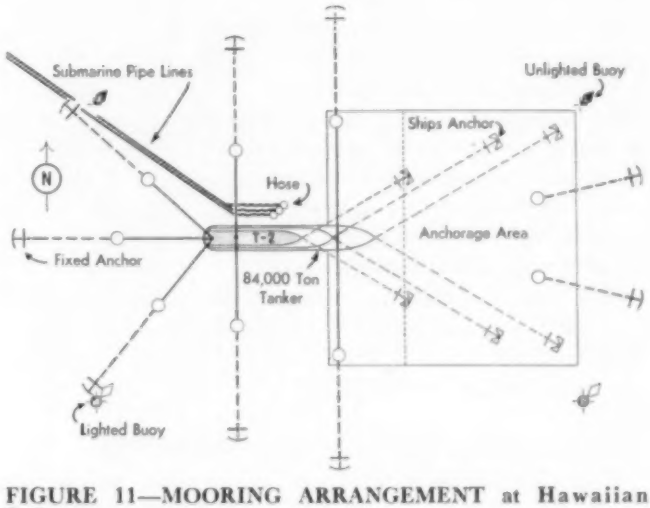


FIGURE 11—MOORING ARRANGEMENT at Hawaiian Refinery.

problem of the ocean bottom. It is smooth and hard as a rock. Our California Shipping Company people made tests to see if a ship's anchor would hold, or at least "hang up" on coral heads. But the dropped anchors dragging on the bottom would barely check a vessel's momentum from the weight of anchor and chain; they could not be relied upon for help in maneuvering a ship into the moorings or to hold it in place.

The "heading" to be selected also gave us some concern. The prevailing trade winds at this location blow *from* shore, while the relatively small currents parallel the shoreline. Because of difficulty in getting into the moorings, it would not be feasible to use a heading with the vessel pointing out to sea.

Finally, we had a submarine pipe line problem. The underwater portion would be over two-miles long and would go through the surf at an angle across a rocky shoreline.

Alternatives Considered. Although we felt that a sea terminal was the best solution, we looked at other possibilities. A sea island for berthing was out of the question. The cost in 65 feet to 70 feet of water in open sea would be prohibitive. No possible saving in tanker time at our refinery throughputs would justify the expense.

Some type of small "island" structure to which the

tankers could be moored by the bow seemed to be worth looking into, but the cost of even this smaller structure, plus uncertainties over mooring and hose-handling problems with an unproved design, caused us to abandon this possibility. We were briefly intrigued with a monomooring, but we gave up this possibility because it seemed to represent too great a step from the small mooring buoys previously designed. We could not jeopardize refinery operation with a device having so many untested features.

This elimination of alternatives left us back where we started—determining how to use a conventional submarine line sea terminal at Barbers Point.

Moorings. Once a sea terminal had been decided upon, our marine people asked that we do everything within reason to "rough-up" the bottom so that it would hold ship's anchors. To do this, we considered both giant rooters and explosives. Explosives seemed most practical, and pilot tests did show that explosive charges laid on the ocean bottom would break up the coral.

The location of the terminal is shown on Figure 10. The water at this location is 70 feet deep. The heading of the ship in the moorings was selected parallel to shore. This permits tankers to take the most common trade winds on the port bow quarter when in the berth. It is also an acceptable position for the ship if she must leave the moorings in an emergency.

A 7-buoy mooring was used, as shown in Figure 11. The arrangement of the buoys had to be such that tankers ranging in size from T-2's (17,000 dwt) to future 100,000-ton giants could use the terminal.

BLASTING ANCHORING AREA BOTTOM

The most spectacular part of the job was to prepare the bottom in the anchorage area. After considering several "designs," we decided that large trenches blasted in a chevron pattern (Figure 12) offered the best chance of success. The trenches had to be wide enough so that flukes of the very largest anchors would not slide across without taking hold. The trenches also had to be deep enough to let the anchors engage solid coral, with little chance of breaking off a "skin" of surface coral. The direction of the trenches was chosen to be approximately at right angles to the anchor chains of ships in the moorings.

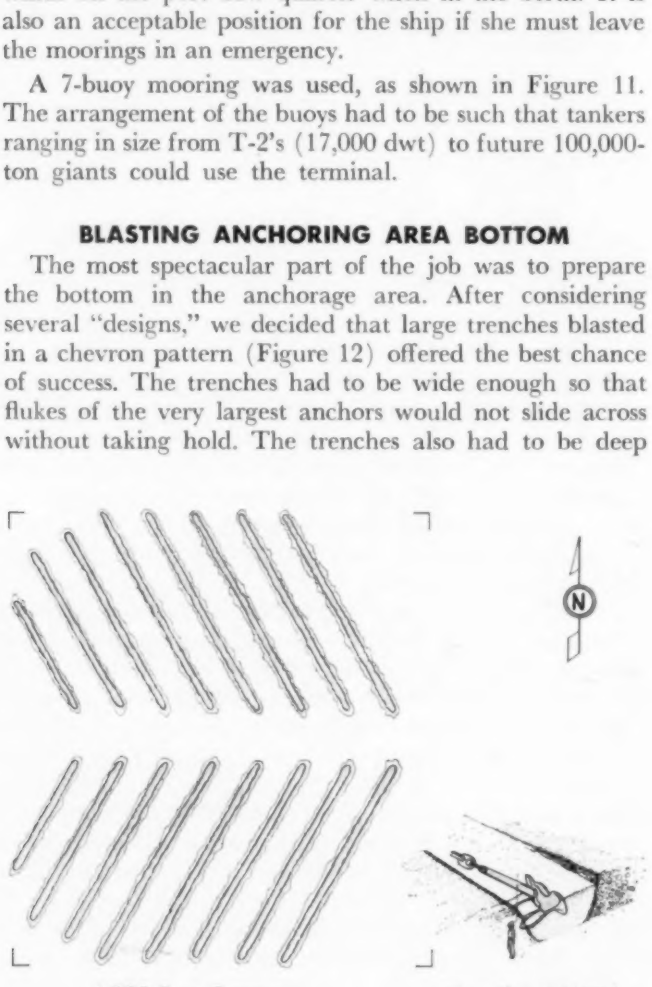


FIGURE 12—ANCHORAGE AREA was trenched with explosives to provide grip for tanker's anchors.

The first step in the trenching operation was to place "cratering" charges on 15-foot centers. These charges were 50-pound shots of 60 percent blasting gelatin. Two strings of cratering charges, each 650 feet long, were fired together. They produced craters approximately 6 feet in diameter filled with pulverized coral. These initial craters were cleaned out with air lifts. Expansion charges of "Nitramon" were then placed in the clean craters and exploded. The result was a series of "trenches" made up of overlapping craters 15 feet or more in diameter. Rubble formed in the craters was left in place.

As soon as a full trench had been excavated, California Shipping Company brought in a tanker for an anchoring test. Its anchor held firmly in the "trench," the solution was proved, and bottom preparation was carried to completion.

You will note in Figure 12 that we also provided two permanent bow buoys at the edge of the prepared anchorage area. As a further safeguard to vessels in the moorings, lines can be run over the bow to these buoys in moderate or heavy weather when it would be unwise to depend absolutely on the holding power of ship's anchors in the coral trenches.

SUBMARINE PIPE LINES

After considering various operating methods and studying the economics of several systems, we selected the following lines:

Crude Line: 30-inch submarine pipe line with a 6-inch internal heating line. Hot water in the internal line will be used for heating if a waxy crude should be left in the line in an emergency, or if heating is needed for some other purpose. The hot water for heating will be wasted to the sea. The internal line is also provided with a submarine hose and can be used for light products or clean refinery stocks.

Bunker Line: 20-inch submarine line with 4-inch internal heating line. For this system, hot water in the heating line will be used to preheat bunker fuel in the system and permit bunkering to start. Additional heat will not be required during normal bunkering operations. The hot water will be wasted to the sea.

A feature of both systems is the careful attention given to design and fabrication of the internal heating lines. After installation, both internal lines were pretensioned cold to 17,000 psi to insure that they will remain in at least slight tension under usual operating conditions. With this pretensioning, the heating lines will have no tendency to expand—and perhaps buckle—as they might if neither stressed nor effectively guided. For protection and weighting, both lines are mastic coated and covered with a concrete jacket. The lines are also under cathodic protection.

No ballast disposal facilities are provided. Most vessels using the terminal are large tankers coming in loaded. They take on salt water ballast for their return voyages.

Continued on Page 65

A Digest: How to Make Pipe Line Management More Effective

Here's a plan for keeping our crude and products lines competitive—and profitable!

By A. J. Helmbrecht, Executive Vice President
The Buckeye Pipe Line Co., New York City

CAN YOU RECALL some of the business organizations which have completely disappeared from the American scene? The automobile industry provides numerous examples. What memories, for instance, do the names, *Pierce Arrow, Chandler, Stutz Bearcat* and others recall, and why are they no longer with us?

There are numerous reasons why companies fail to survive in the competitive race—financial problems, product obsolescence and disappearance of markets, to mention a few. But an adequate, well organized corporate structure might have solved such problems, and spelled the difference between survival and oblivion in many cases.

As competitive organizations, how do pipe line companies stack up today? First, let's examine the features of a typical pipe line organization and identify those which it shares with other corporations and those in which it is unique.

First and foremost, a pipe line company is a service organization serving relatively few customers. My own company has 35 customers and this figure is rather high for the industry. Thus, sales effort is limited.

Investment in plant is generally high in relation to sales and the number of employes. (The 1959 Interstate Commerce Commission report shows that the 86 reporting companies average 258 employes, and this includes several with more than 2,000 each.) The principal items of expense are the cost of invested capital, the cost of labor and the cost of energy. The matters of rate of return, accounting and conditions under which it serves its customers are regulated by the Interstate Commerce Commission. Summarized, the relatively stable business of a typical pipe line with the restricted rate of return and low depreciation rate favor a capital structure with a comparatively high ratio of debt to equity.

Transportation cost is one of the major elements in the price of petroleum products to consumers. Had the efficiency of pipe lines not been so high, many of the benefits resulting from the discovery of oil would have likely been lost. We can be proud of the fact that a gallon of petroleum can now be transported 2,000 miles for half the cost of mailing a letter!

But despite our obligation to our society and the services we render, the fact remains that from the owner's point of view, our reason for being is *profit!*

Surprisingly, the presumption that profit is always the primary corporate objective is simply not valid. All of us can recall companies where the desire for growth, or a sentimental attachment to outmoded products has interfered with profit objectives. Yet, within the framework of regulation and public service, profitability is and should be our main consideration. Our owners have every reason to expect a profit from our efforts just as have the owners of a factory, etc. We must receive more for our service than it costs to render it, or we cannot long survive.

MANAGEMENT EFFECTIVENESS THROUGH ORGANIZATION

Management effectiveness is the key to this achievement and it must come through the planned organization of a competitive pipe line company. The organization of any enterprise should provide three basic factors:

1. It should clearly establish definite corporate objectives and goals
2. The organization should be planned to best attain those objectives
3. A method should be devised for continual evaluation of the organization in achieving its goals with replanning where indicated.

The general organizational trend is toward "decentralization." But in the case of pipe lines, "divisionalization" is perhaps a better description of a system of organization where each geographical division can be held accountable for its own costs, but because of its lack of control over volume or "sales" cannot be held completely responsible for its own profitability.

This form of decentralization permits authority commensurate with responsibility at each level of management so that the function of top management will not become bogged down in the detail of everyday decisions of a lower order. In addition, there is no better way to create a proving ground for future management talent. For decentralization affords more people down the line the opportunity and necessity of making decisions, and the consequences of their decisions can readily determine their future careers within the organization.

There are many approaches and degrees of decentrali-

About the Author

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zation. Each management must determine the lowest level to which it wishes to develop line responsibility and the highest level that is to become involved with day-to-day operations. Decentralization permits the separation of policy making and long range planning from day-to-day operations. It frees management's time for the very important responsibility of keeping alert to the possibilities for profitably expanding the organization's facilities and services. The critical problems of today such as competition, profit squeeze, law and regulation, continue to make increasing demands on the time of top management and tend to divert its attention from its two basic duties; namely, establishment of objectives and long range planning for their implementation. Management's attention should be focused largely on the future with less concern with the day-to-day operating problems. As we go down the chain of authority this direction of concern should change; with more and more emphasis on the immediate daily problems at increasingly lower levels.

Functions of Line and Staff. On the line side is the president, whose time should be as free as possible from detail in order to concentrate on over-all corporate policy, the maintenance of customer contacts, the promotion of new business and the retention of the old. He should avoid becoming overburdened by having too many subordinates reporting directly to him. This is not to say that he should abdicate his authority in reviewing the decisions of those subordinates, but he should not be expected to be available for approval of each of their day-to-day actions.

If only one position were to be chosen for reporting to the top, it should be the executive vice president, for he is the man who "minds the store," knows what is going on, and can quickly bring the president up-to-date.

The operations of many pipe lines are voluminous and widespread enough to justify the existence of more than one vice president. It may also be desirable to have operating vice presidents at the head of one or more divisions with all phases of activity reported to them for decisions at their level, and as the channel through which must pass matters requiring higher consideration.

A system of organization has, therefore, developed with clearly defined areas of responsibility and authority designed to avoid overloading at each level. From here on down the line are those classifications with which we all are familiar. This seems to be the logical place to stop as far as line management is concerned.

The staff should operate solely within the area of advice and counsel to the line. Frequently, staff men tend to become specialists and experts in their respective fields, and there is a great temptation to use a separate individual for each staff function. But a periodic examination of the work load in staff positions can often reveal the possibility of functional consolidations which would accomplish the dual goals of reducing personnel and broadening the perspective of the individual. Another widely used technique for preventing overly rigid thinking and performance of staff men, is a periodic rotation of assignment. The challenge of new responsibility frequently reveals unsuspected talents and abilities in individuals which can be directed into more productive channels toward achievement of our objectives. Certainly from the standpoint of the organization, a big dividend derived from this rotation of assignment is the development of a broad source of talent from which to draw to fill those gaps which seem inevitably to occur in every organization.

Fortunately, the organization of a pipe line is well suited to achieving a "one-boss relationship." No man can operate effectively when he is required to report to more than one level or individual. He must know from whom his orders will come and to whom his reports will go.

An easy test of the effectiveness with which an organization has delineated its functions, is to request from each individual a written statement outlining briefly his understanding of his own responsibilities, to whom he reports, who reports to him and what that individual's responsibilities are. It is not at all unusual to find that one individual believes a second reports to him while this second individual with equal conviction believes he reports to someone else. These simple reports can provide the basis for an effective clarification of lines of authority and responsibility.

What value shall we put upon the use of committees in the direction of a pipe line? Many times a decision must be made or policy defined, requiring the research, exchange of ideas and experience of a group with widely diversified backgrounds. A committee can be an excellent sounding board and proving ground for testing those individuals who have given an indication of being likely candidates for executive development. Or the committee can be used as an administrative device in instances where a distillation of thought from various staff functions is required. As an example, I have in mind the administration of a benefit plan where the combined viewpoints of the legal, accounting and personnel functions should insure the best administration. If a committee is to be a valued aid in decision-making, the area of the problem and the objective of the committee should be clearly defined. Above all, the committee should not be perpetuated. Once its job is done, it should be disbanded immediately.

We should consider what an existing company can do to improve its competitive position. If management effectiveness is the solution, we must determine where we are going to get the people to provide that effectiveness. The most logical place is from existing personnel. An evaluation of all personnel may uncover hidden talent in our

human resources. Also, it may uncover dead wood which will have to be pruned from the tree in order for it to grow in the forest of competition. This is an ideal spot for a committee assignment because much time and thought must be given to the establishment of bases of evaluation and orderly and effective procedures for the institution of corrective measures. Such a program must have acceptance at all levels of the organization and this will not be achieved unless the remedies are equitably planned on a long range basis.

Planning for the Future. Just as the use of human resources should be planned for tomorrow, the expansion possibilities of present outlets should be explored. Management at all levels should be impressed with the importance of this phase of corporate continuation. Research should be conducted by a qualified group within the company into the practicability of new endeavors or diversifications. The ideas resulting from that exploration and research should be collated, analyzed and placed in proper perspective for top management's consideration and approval. The expense involved in today's long range planning and development can well be an investment for tomorrow's survival.

The evaluation of the results of our effectiveness is best found through the comparison of our actual expenditures with our budget forecasts. If the philosophy of planning at all levels has been properly communicated, the foreman of the pump station should be just as anxious to find his unit operating efficiently as is the top manager anxious to see that the over-all picture is in line with that which had been previously planned. If expansion has been an objective of the company, then this should be reflected in an increase in volume of traffic, an increase in plant investment and lower unit costs. Again there should be a periodic review of lower level function to determine if decisions have adhered to defined policy. While it is relatively easy to pinpoint the results in cold figures, an evaluation of the intangibles such as employe unrest and frequent accidents to employes and equipment, resulting in a creation of future operating problems should not be overlooked. If the analysis of results shows a poor picture, then replanning is indicated.

To summarize, today's competitive pipe line company regardless of type of ownership, having corporate objectives in no way different from other free enterprises, has evolved a structure similar in many ways to that found in most other corporate endeavors. There is no reason to expect it to be otherwise. The decentralized type of organization seems to provide the best answer to the proper balance between authority and responsibility at all levels, and puts each decision at the level commensurate with its importance.

It seems safe to conclude that if a pipe line company provides clearly defined objectives and policies, a structure designed to implement these objectives and a system for continually evaluating the results against its objectives with replanning where necessary, it has achieved the competitve organization which will provide its transportation service at lowest cost with highest profitability and maximum opportunity for growth.

ACKNOWLEDGMENT

From a paper presented at the Annual Pipeline Conference of the API Division of Transportation, April 26-28, St. Louis, Mo.

Designing and Using Offshore Tanker Moorings

Continued from Page 62

Other small vessels running to the Pacific Coast refineries will arrive with small amounts of ballast that will be kept on board.

CONCLUSIONS

We have covered only a few of the challenging problems involved in the design, construction and operation of offshore tanker moorings. Perhaps enough has been said, however, to support the following conclusions:

1. Offshore tanker moorings are a versatile and economical solution to the problem of securing tankers so that they may be loaded or off-loaded in locations where conventional harbor facilities are inadequate or not available.
2. Design of offshore tanker moorings requires close cooperation between engineers and marine operating people. The counsel of experienced tanker masters is most important.
3. Mooring components can be improved. We need reliable mooring systems that take less space and provide more freedom to the ship than the present 5-buoy and 7-buoy sea terminals, which in turn provide considerably more freedom of movement than a sea island. The mono-mooring affords possibilities toward this goal, but experience does not yet warrant a positive endorsement of this type of structure.
4. Accurate and dependable meters of very high capacity are needed to eliminate gaging tankage and reduce total tankage to the minimum required to accumulate shipments.

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Report on Operating Underground LPG Storage Facilities

Operating problems and their solutions

By G. P. Jennings, General Superintendent
Products Pipe Line System, Phillips Pipe
Line Co., Bartlesville, Okla.

BECAUSE OF ITS RELATIVELY LOW CONSTRUCTION COST and high factor of safety, underground storage is ideal for LPG and other high vapor pressure products. However, it is not a cure-all. In some cases, operating costs and problems are increased as compared with conventional pressure storage.

This seems to be the consensus of more than 50 operators of underground storage facilities who were contacted prior to the preparation of this paper.

What's Stored Underground? Propane and butane comprise the bulk of underground storage; however, other high vapor pressure products such as ethylene, propylene, natural gas liquids mix, olefin feed stock, isobutane and butylenes are also stored underground by some companies. But because propane and butane are the most common, all of our discussion will apply to these products unless stated otherwise.

There are three types of underground caverns. They are:

1. Conventionally mined caverns in impervious rock.
2. Solution mined cavern in salt dome.
3. Solution mined cavern in salt bed.

The mined caverns and the salt domes present only the usual operating problems. The salt bed, however, can present very difficult problems.

MINED CAVERNS

The mined cavern is constructed by mining a cavity from shale or rock. The depths usually range from 250 to 400 feet below the surface. The mine shaft is sealed, and one or more vents or fill pipes are installed.

Filling Problems. The older mined caverns are usually filled through a *fill pipe* which may simply penetrate the roof or run all the way to bottom. Either way, the compression of the vapor as the liquid level rises, generates heat and pressure which is, of course, undesirable. One solution is to withdraw vapors, compress and condense them, and return the resulting liquid to the cavern.

Spray headers suspended near the ceiling of the cavern effectively reduce cavern pressures during fill. Without spray filling, light ends, principally ethane, tend to build up in the vapor space and occasionally must be removed by venting and burning or by condensing as mentioned above.

Off-specification product will stratify and not mix with other products in the cavern. Adequate circulation is usually not available for blending.

Pumping From a Cavern. Because cavern depth is usually not over 400 feet, more or less conventional deep water well pumps are used in pumping from the cavern. This operation is virtually trouble free. Some companies discharge the liquid from the cavern direct to loading; others, pump into a surge tank and load with a conventional pump.

Using Vapors for Discharging. Some companies empty the cavern by compressing vapors from the vapor space of a surge tank and reinjecting the vapors into the cavern. The liquid is thus pressure lifted into the surge tank and pumped off to loading operations with a conventional pump. This method has the advantage of no moving equipment in the cavern, but it has the disadvantage of higher power costs.

Gaging is usually accomplished with a float-type level indicator. Other devices such as a differential pressure-type level indicator are also used as a check on the float gage. Since caverns have an irregular shape, it is necessary to correlate the volume in the cavern with the gage reading. This is usually done with an orifice or positive displacement meter measuring the product in or out of the cavern.

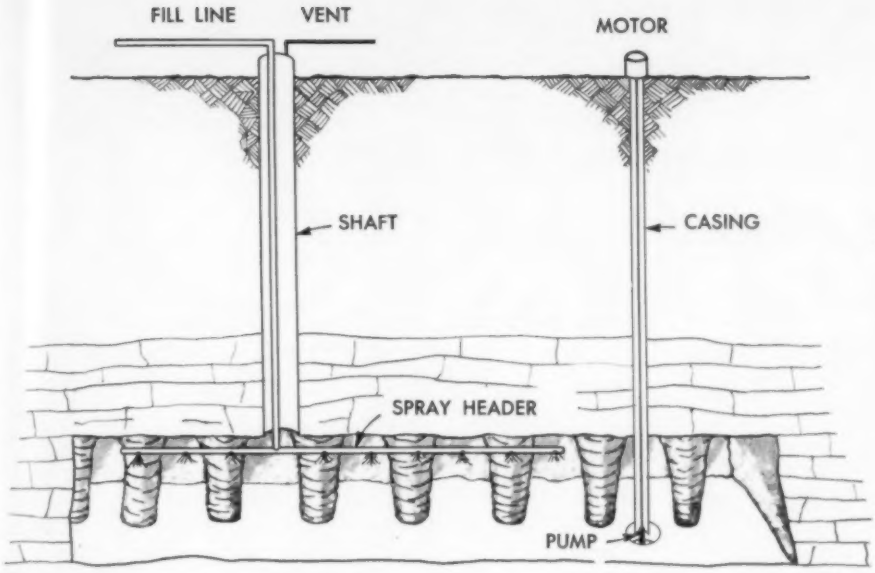
The maximum permissible operating pressure is established by following the Natural Gasoline Association of America tentative standard. The cavern is thenceforth protected from over-pressure by relief valves and pressure monitoring equipment.

Losses are quite low, apparently one percent or less.

SALT DOME CAVERNS

There are more than 200 salt domes in the Gulf Coast region from the Mexican border to Alabama. They are from ½ to 7 miles in diameter, lie 500 to 1,000 feet below the surface of the ground and are 10,000 to 30,000 feet thick.

How the Salt Dome Cavern is Constructed. Fresh water is used to wash a cavern in the salt. First a hole is drilled into the salt, casing is run into it and cemented as shown. A second string of pipe—the protective string—is run inside the casing and tubing is run inside of it. Fresh water is then injected down the tubing and salt water is removed up the protective string. To control the shape of the cavern, a hydrocarbon blanket is maintained



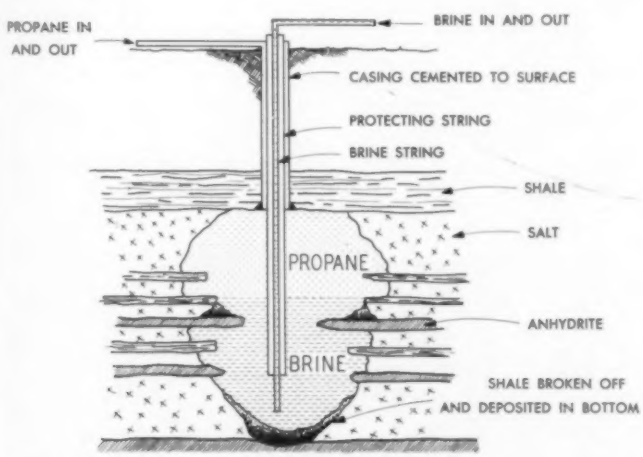
MINED CAVERN. One of the innovations of recent years is the spray header which reduces heating during filling operations.

above the bottom of the protective string, and by adjusting elevation of the string, the section of salt exposed to fresh water can be controlled.

Filling the Cavern. Upon completion, the cavern is of course, full of brine. Product is then forced down the casing and the brine is forced up through the tubing string. (The protective string of pipe can be removed or left in the hole.) As the brine is displaced during the filling operation, it is often saved for future use by storing in a brine tank or an open pit. Sometimes, it is stored into a shallow well for future recovery; otherwise, it may be wasted into a disposal well or open brine pit.

Emptying the Cavern. Normally the cavern is emptied of product by returning the brine to the cavern by gravity flow or by applying additional pressure if higher emptying rates are desired.

Open brine storage pits are sometimes constructed with a lining if the soil is too porous or not otherwise suitable for retaining brine. Others are lined with asphalt plank, asphalt paper sheeting, synthetic rubber sheeting, polyethylene film or sprayed concrete. One company has an open pit with a storage capacity of 1,200,00 barrels. A burn tank is sometimes located near the center of the pit where a pilot flame continually burns to ignite any escaping gas from well tubing failures or normal product carry over.



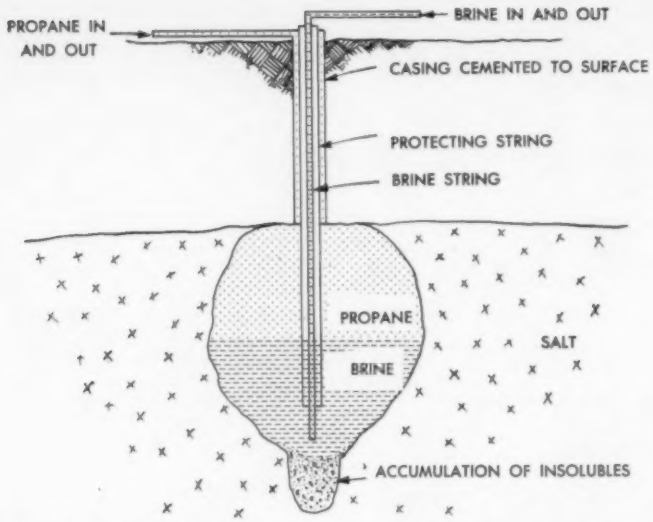
SALT DOME CAVERN. This is a highly successful method of underground storage. Sometimes the protective string of pipe is removed prior to operations. However, the string can serve as a tell-tale indicator where ethylene is the stored product. Normally, brine is pumped in to replace the product and removed from the cavern during filling.

Enlarging a Cavern After It Is In Service. Brine is not always used for displacement. If a cavern is put in service before it has reached its desired capacity, fresh water is used to displace the product. In this way the size of the cavern is increased by about 15 percent for each complete cycle of filling and emptying. Another variation of this enlargement process is to drill and start washing another cavern. Then pass the fresh water through the new cavern where it becomes brine and then into the cavern for displacing product where no further enlargement is desirable. From the above discussion it can be seen that whenever fresh water is used the total cavern capacity is becoming greater whether needed or not. With the normal growth of business this increase of capacity is frequently desirable. However, if no further capacity is wanted, the only solution is to provide brine storage practically equal to the product storage capacity or to keep making brine caverns as previously mentioned. This is a question of economics.

OPERATING PROBLEMS

One common problem in salt dome cavern operation is the precipitation of salt in the brine string tubing. Salt domes have an earth temperature of up to 130° F and the brine in the cavern becomes saturated at this temperature. Then, when the 130° F brine comes up through the brine tubing, flowing countercurrent to the much cooler product going down through the casing, the brine is cooled below its saturation point and salt crystals deposit to either reduce or stop the flow. This problem is, however, easily solved by a fresh water wash through the brine tubing string. This salt buildup also occurs at flow restriction points such as pumps, throttling valves, christmas tree ports, etc. Here again it can be easily removed by flushing these passages with fresh water.

Sump. The anhydrite content of the salt sometimes causes an insoluble "sand" build-up at the base of the



SALT BED CAVERN. Trouble comes from stringers of shale that extend through the salt beds. Sometimes, they break off, to deposit on bottom, or even to shear pipe.

cavity. This reduces the available cavern space; and for this reason, when the cavern is initially washed, a sump or storage chamber is often provided in the bottom of the cavern to catch these insolubles.

Abrasion. The brine effluent from the cavern may contain abrasive materials (sand, dirt and undissolved solids) which may scour and erode steel if the velocity of flow is high. It has been recommended that consideration might be given to wall thickness of bends, tees and elbows in the system.

Leaks. Caverns in ethylene service have experienced tubing string leaks. This condition has been improved by the use of couplings with teflon ring inserts. Hydrates forming in the ethylene lines also cause some minor trouble.

Inventories. Various means are used to provide fairly accurate cavern inventories. A "Photon" survey, when used in combination with a sonar caliper, is reported to give accurate well inventories. Some meter the product in and out with orifice meters and others use positive displacement meters. One company uses dual flow positive displacement meters with printer heads.

SALT BED CAVERNS

The salt bed cavern is constructed in much the same manner as salt domes. The operation is also practically identical: the brine is displaced during product filling and the brine is returned to the cavern to displace the product for removal. Fresh water, if used, of course, increases the size of the cavern and there is always the problem of brine disposal. Precipitation of salt in the brine string tubing is not normally encountered as in salt domes because of the lower cavern temperatures. However, some do have this trouble, especially in extremely cold climates.

The Trouble With Salt Beds. Nearly all salt beds have one big operational headache. The shale ledges slough off and shear or kink the tubing. If, during the filling cycle, the brine tubing string breaks off in the LPG space, above the brine level, the product will flow out the brine string tubing to the pond or other brine storage space. This same problem can exist if the cavern is over-filled thus depressing the brine surface below the bottom of the tubing string. Several operators provide a flare in the pond to burn the product if it should escape thus reducing the potential hazard. One company uses a rate of flow device which operates when the brine string is flowing propane at a higher rate of flow than is normal while flowing brine. At least one company uses a conductivity probe on the brine line which gives an audible alarm at the first indication of LPG in the brine leaving the cavern.

Shale Stringers. Some operators report that they avoid removal of the tubing string from the hole as it is often difficult, if not impossible, to replace it without it hanging up on the shale ledges. As shale stringers break off and fall to the bottom of the hole, it is necessary to raise the brine tubing string. Some of the available capacity of the cavern is thus lost. One operator has considered using a jetting tool that will remove the debris from the bottom. One company reported that two caverns had washed together thus making one cavern of nearly 200,000 barrels. Another cavern developed a leak to the surface. It was then necessary to use only the top fourth of the cavern above the leak. Cavern inventories are maintained in the same manner as with salt domes.

Using Gas for Pressure. One company, storing deethanized gasoline, uses natural gas at 1,000 psi to displace, or that is, to remove the gasoline. When the cavern is filled with product the gas is pressured back into the gas pipe line. Gas absorption into the product has not been a problem.

Trading Brine. One company is in a unique position in that they are located close to a salt company. Arrangements are worked out so that the salt company will accept excess brine and when brine is needed they will supply the brine needed by the cavern for product displacement.

COMMENTS

It is general practice to dry the product as it is removed from the caverns. In some cases, especially in mined caverns, this is a precautionary measure only. Various types of dryers are used.

Most reports indicated that losses were either negligible or up to 2 percent at the most.

ACKNOWLEDGMENT

From a paper presented before the Annual Pipeline Conference of the API's Division of Transportation, St. Louis, Mo., April 26-28, 1961.

About the Author

G. P. Jennings is general superintendent of the Phillips Products Pipe Line System. He graduated from Rensselaer Polytechnic Institute in 1923, worked for the Worthington Corp. for three years as a service engineer and spent three years in the zinc industry as a design engineer. Jennings joined Phillips Petroleum Co. in 1930, spent eight years in general design work and transferred to the pipe line operation. Since then he has served as engineer, chief engineer and superintendent of operations.

INTERIOR SECRETARY UDALL
More active participation

Bigger Role for Interior Dept.?

How Secretary Udall Views Issues Affecting the Pipe Line Industry

- More potent Oil Imports Administration
- Reorganize Office of Oil and Gas
- Early action on oil, gas and coal matters
- Close look at Canadian imports
- Consumer interest is paramount

These are just a few of the objectives announced by Secretary Udall in this exclusive PIPE LINE INDUSTRY interview.

LIKE PRESIDENT KENNEDY in the White House, Secretary Stewart L. Udall has brought a new brand of executive vigor to the Interior Department.

Since his unanimous confirmation by the Senate January 21, he has become well briefed on every point of the Interior compass and is taking a personally active part in the formulation of plans and policies on other levels than the final decision-making plateau.

Secretary Udall's continuing interest in matters pertaining to the industry was recently summed up by Lawrence J. O'Connor, Jr., OIA administrator, who said:

"Secretary Udall has taken—and, I am sure, will continue to take—an increasing role in petroleum affairs, one far greater than any of his more immediate predecessors. Decisions affecting oil will be made with greater public participation, of greater public awareness of their impact on our society, and in a larger frame of reference of the greater public interest. Decisions will be made forthrightly, with no illusion that compromise can substitute for determination—with no illusion that hard decisions which meet full responsibility will satisfy all particular interests."

To ask the Interior secretary what action he plans to take on many key issues is to learn that he already has begun to act upon them. For instance:

On potential changes in Interior's oil and gas regulatory agencies and their functions—"I hope to strengthen both the Office of Oil and Gas and the Oil Import Administration. I can assure you there will be some personnel changes. Our over-all goals and objectives are to stabilize and strengthen the (energy producing) industries and to assure adequate supplies where they are needed at prices fair to the consumer and profitable to the producer. We are striving for a balanced and productive program."

Actually, Secretary Udall had already acted to strengthen the regulatory machinery for petroleum and gas by appointing John Kelly, of New Mexico, as assistant secretary for mineral resources. The new assistant secretary has headed his own oil producing firm for 15 years; is both a graduate mining engineer and petroleum engineer, and is a former executive director of New Mexico's Oil Conservation Commission, which he helped organize.

"The Office of Oil and Gas is to be upgraded, and a very top level, qualified executive is going to head it—whenever we find him," said Secretary Udall, adding that the "dragnet is out."

To help him find top level men to guide oil and gas regulation, Udall has brought in Major J. R. Parten, of Texas, as a special consultant. The duties of Major Parten, long an ambassador from the oil industry to top level state and federal government include "helping with personnel and strengthening oil and gas organization within the department."

While neither Udall, Kelly nor Parten are yet waving new organization charts, the framework to make Interior the real and active nerve center of governmental domestic and international concern with petroleum is definitely under construction.

Secretary Udall says the functions of Interior's agencies concerned with oil and gas—and coal—will be upgraded on a par with such agencies as the Geological Survey, which is headed by top scientists. The energy producing industries have been told to help find the qualified personnel.

Interior's interest in petroleum is global: "We expect to strengthen and stabilize the oil and gas industries in ways that will enable them to contribute substantially to the rate of national economic growth, and to achieve, by day-to-day efforts, our other appropriate long-term national

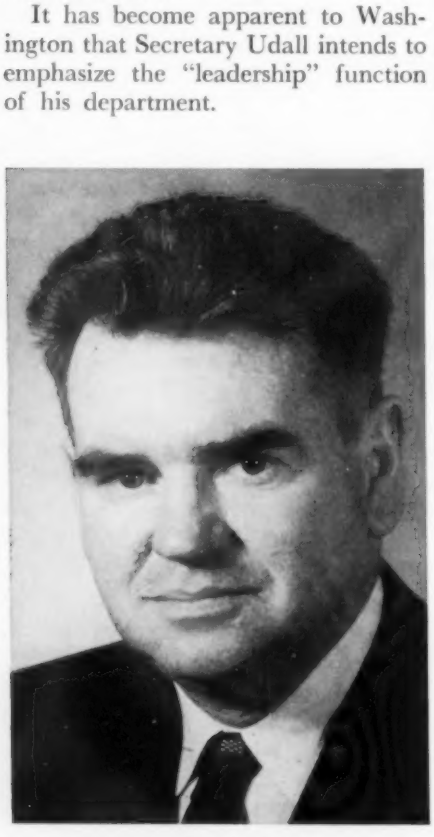
goals. We also expect to make those proper adjustments necessary to the world situation which is of increasing importance," the secretary said.

Earlier, to the National Petroleum Council, he had stressed the need for national policies on oil and gas and described those industries as "the core of America's economic and military strength . . . pivotal to the welfare and cohesion of the free world."

The accepted functions of the Office of Oil and Gas are:

- Staff advice and assistance (to the assistant secretary for mineral resources) on programs assigned to the department by the White House and Congress.
- Leadership in coordinating oil and gas policies in the federal government to assure adequate facilities and supply in time of peace and war.
- Serve as principal channel of communication between the federal government and the Interstate Oil Compact Commission, state regulatory bodies and the oil and gas industries. Carry out the provisions and functions authorized by the Defense Production Act of 1950.
- Appoint and train a National Defense Executive Reserve for Petroleum and Gas.

It has become apparent to Washington that Secretary Udall intends to emphasize the "leadership" function of his department.



JOHN KELLY
Assistant has oil background

The Oil Import Administration was established by Presidential Proclamation under the Secretary of the Interior. It is staffed and serviced in part by the Office of Oil and Gas, and depends now for its basic statistics on the Bureau of Mines. The Import Appeals Board is distinct from the OIA.

On proposed increase in Canadian imports: "The plans of the Canadian government to increase the marketing of hydrocarbon exports to the United States, as the Department of the Interior understands these plans, would result in a gradual increase in Canadian imports of crude oil, condensates, and natural gas liquids over current levels during the next three years.

"From our talks with the Canadian representatives, the proposed planned increases would move predominately into the Pacific Northwest where they will largely displace other imports rather than domestic production. A lesser quantity would move into the upper Midwestern area which is currently served, to a large degree, by Canadian imports. When these quantities can be more accurately determined, we feel assured that this information will be made available to the United States Government and to the domestic producers of our nation.

"Within the framework of the announced Canadian plan the contemplated increase in imports of hydrocarbons—properly and orderly timed—should not materially affect oil production within the United States.

"Speaking candidly, however, I feel compelled to say that, if the plan is not implemented by gradual steps, it could conceivably work against the interests of the domestic oil producing industry in the United States. Our domestic producers understand the policy considerations which underlie the current exemption of Canadian imports under the mandatory oil import program. However, if the Canadian plan has a marked and abrupt adverse effect on our petroleum industry, such action would undoubtedly furnish the basis for a review of the pattern of U.S. oil import controls as they pertain to Canadian crude oil, condensates, and natural gas liquids."

On the investigation of fuel prices: "The Department of the Interior, along with the Justice Department and the Federal Trade Commission, is continuing an investigation asked by President Kennedy on increases of fuel oil (distillate) prices in certain areas," Secretary Udall said.

He declined to map the area of the investigation or to say when it would be concluded. He noted, however, that heating oil prices had receded in certain areas since the investigation began. "The more they recede the better," he remarked.

The Anti-Trust division of the Justice Department said its investigation embraced both No. 2 heating oil and residual. The Justice spokesman, too, was not inclined to reveal the extent of the investigations or if they would be extended beyond the East Coast area.

Secretary Udall said the Interior Department would not, as a matter of policy, undertake oil price investigations as a general rule. He added that part of the function of the OIA was to keep an eye on price fluctuations.

On a national fuels policy: Whatever Congress finally decides to do about a national fuels policy study or a national fuels policy, Udall is not in a mood to wait on it. Earlier he had said on the subject:

"You, of course, could have a congressional study, you can have executive studies, or you could have a joint one. Actually, the broader the base you get on it the better, it would seem to me, as a matter of policy." Since then he has apparently had second thoughts.

"Here at Interior we can't sit still and wait for a drawn out study before we act on matters concerning the major fuels," he told PIPE LINE INDUSTRY. "We inherited an ad hoc situation January 20 and we have had to act from day to day on problems and situations as they arise and demand attention. Actually, we are conducting a continuing fuels study and will continue to do so.

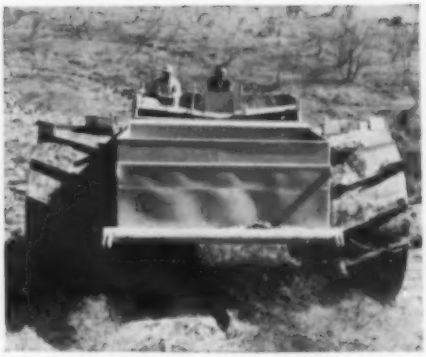
"The long public hearing on residual oil imports was in itself a study. We got the views of all factions of the industry, weighed the many considerations and then took action we thought would serve the country's interest best.

"The lack of a formal national fuels policy may be something of a handicap, but actions can't wait until one is finally formulated."

One broad policy relating to fuels which Interior along with the White House seems to have formulated is that, in the words of Secretary Udall, "The interest of the consumer is paramount!" —The End

Ideas for the Future

By **Donald M. Taylor,** Engineering Editor



Alaskan cargo vehicle can tote 10 tons over snow, mountains and water

The roadblocks that have held back the development of Alaska's fabulous mineral deposits are literally "roadblocks." For roads through the sparcely settled and rugged country are few and far between, and during winter months, snows, avalanches, etc. limit their usefulness.

Some have said that the key which will unlock the treasure chest of this frozen land of beauty and riches will be a cargo vehicle which can traverse snow, ice, mountains, water and brush.

This idea fired the imagination of Weldon Appelt, well-known engineer and president of Clear Span Engineering Co. About two years ago, following a hunting trip to Alaska, he set out to develop such a vehicle. This was first reported by PIPE LINE INDUSTRY in January 1960, page 47. At the time Appelt had made preliminary designs and had started work on a prototype model.

Since that time he has completed and discarded two prototype models of his "Trailbreaker" and finally constructed a third which has passed a rugged testing program with flying colors.

For the past three months the monster vehicle shown in the accompanying photographs has been churning across a small lake near Houston, slogging through quicksand, climbing 40 degree slopes and running speed trials while loaded with 20,000 pounds of weight to simulate its cargo. These tests have been carried out under the watchful eye of a professional Alaskan guide and business man, Bill Monroe. Now the only remaining tests must be carried out in the hazardous terrain of the Alaskan countryside, and the vehicle will be shipped northward via the Alcan Highway this month.

The vehicle is a "kiddycar." It has three wheels—the two in front which drive it measure 11 feet in diameter not counting their one-foot-deep cleats which bite into the snow, sand and water.

Power for the vehicle is provided by two 210-horsepower gasoline engines—each one driving a front wheel. This can give the monster a speed of 14 mph on land and enable it to climb grades ranging up to 40 degrees in slope. Equipped with its land and snow cleats, the vehicle can manage two miles per hour in water. But by the addition of special cleats this speed can be upped. In addition, the unit has a mount for an outboard motor for additional speed across open water. In water, the craft has 64,000 pounds of buoyancy sealed into its three drum-wheels. This considerably exceeds its loaded gross weight of 54,000 pounds (34,000 is weight of the vehicle empty; 20,000 weight of cargo.)

There are two ways of steering the vehicle. One is by using the throttles to the engines which drive the separate front wheels. This is perhaps the most effective method of control. However, the rear wheel can also turn the vehicle; but so far the driver has used it mainly for trimming the craft to compensate for its load in water.

The developers have provided considerable flexiblity in the vehicle. For instance, it would not be difficult to transfer part of the power from the engines to the rear wheel, giving the "trailbreaker" a three-wheel drive. Also, where the vehicle would be used in water most of the time, an engine-driven propeller could be mounted at the rear.

All of the features of the new vehicle are designed for operation in the sub-zero temperatures of Alaska, and it is likely that the time is not too far off, when the strange monster will make its appearance on a pipe line spread in the cold country.

Battelle develops new rust inhibitors

Calcium or zinc molybdates equal or exceed the rust preventive characteristics of red lead and other inhibitors commonly used, say research scientists at Battelle Memorial Institute.

The white molybdates withstood accelerated test in the laboratory and atmospheric born corrosion from the ocean in Florida. As compared with red lead, the material costs more per pound, but it weighs less. Too, it is non-toxic.

New Developments to Watch In Pipe Line Research Field

What are our industry scientists interested in these days?

For the most part, they are busy finding new uses for our products, developing new plastics and working to keep abreast of new sources of energy such as the fuel cells. But the paths that lead from research are broad ones, and several companies have made discoveries in alien fields.

Here are some of our industry's research projects—listed by companies.

United Gas Corporation

Magnetic Tape That Eliminates Punch Cards. To market the discoveries in instrumentation which its research laboratories have developed, United Gas organized UGC Instruments. The newest discovery of this division is a machine that uses magetic tape to record data for processing, replacing punch cards. The machine fits right on a calculator, adding machine, etc., thereby preparing tape for high speed processing at low cost and without the highly trained punch card operators etc.

Fuel Cells That Use Methane and Air. United has constructed fuel cells which use methane in place of hydrogen and scientists are greatly enthused over the high efficiency of the cell. If this proves out, it is one of the most important inventions of our lives and of great significance to the gas industry.

New Way to Make Plastic from Gas Derivatives. United also has discovered a new method of producing methyl methacrylates from isobutylene, a natural gas derivative. This is the plastic used for tail lights and other light fixtures.

Lone Star Gas Company

Better and More Competitive Utilization of Gas. Lone Star is a gas company and almost all of its research directly involves natural gas. The company is working on a thermoelectrically powered gas appliance which will generate all of its own electrical needs. The company will have a large gas-engine-powered heat pump operating this year. Also, the company has made advancements in thermally actuated refrigeration.

Standard Oil Company (New Jersey)

This company spent $68.6 million on research last year! Here are some of the things they received for this great investment.

Using Heavy Oil for Producing Steel. Injecting heavy oil directly into blast furnaces, replacing coal, lowers the cost of producing pig iron and increases plant capacity. Natural gas and heavy oil not only supply the heat, they also supply chemicals needed for reducing the ore into iron.

Asphalt Emulsion That Protects Crops in Arid Regions. By spraying asphalt emulsion over the ground after planting, the water in the soil is preserved until the seeds germinate and push up through the asphalt. Standard will test this method on five different continents this year. A tractor-drawn machine which plants the seed and spreads asphalt emulsion all in one operation is under development.

Colored Plastic Coatings for Asphalt Paving. This will protect asphalt from its worst enemy—the weather, and it will improve its appearance and safety.

Ultrasonic Burner for Fuel Oils. Ultrasonic waves are being used to break up drops of fuel oil into a fine mist which is more readily burned. This could enable designers to come up with improved gas-fired turbines. Also, it will mean better home heating and industrial burners.

Reinforced Resin Pipe as Strong as Steel! Researchers say that Standard's Buton-plastic and glass-reinforced pipe, which is now under test, has the strength of steel pipe. If the tests are successful, the company will market the new pipe late this year.

Miscellaneous. Standard has devised a new method of drying air, has done considerable work in solid fuels and is carrying out extensive research with fuel cells.

Shell Development Company

Oil Well on the Bottom of the Sea. Shell recently completed the first U.S. well on the ocean floor. The wellhead and equipment is 56 feet beneath the surface of the water and no platform is needed to service the unit. In the future, more and more pipe line companies will be confronted with wells of this type.

Plant hormones that keep leafy vegetables fresh and green after harvesting have been discovered by Shell. If successful, this discovery could revolutionize the produce industry.

Asphalt Mixtures. Like several other oil companies, Shell is devoting considerable research to asphalt. Shell has emphasized methods of testing and new materials produced by mixing with other plastics etc.

Phillips Petroleum Company

Plasma Jet research aimed at initiating chemical reactions at the extremely high temperatures which break matter down into ions, etc. has occupied considerable research time in Phillips' laboratories. This ties in with MHD and fuel cell research.

New Discoveries in Atomic Energy. Phillips was sixth in the nation last year among companies obtaining patents, and many of Phillips' patents were in the field of atomic energy. Phillips will be operating 11 nuclear reactors by the end of this year. One of these is producing the highest known neutron intensity. Another is being moderated and cooled by an organic material which Phillips has developed.

Standard Oil Company (Indiana)

Underground Fire for Old Oil Fields and the Tar Sands. In the not too distant future, the vast reservoir of locked in oil—the Athabasca tar sands—may start producing oil. The company is extending its tests in this field this year to evaluate the commercial possibilities.

Gasoline additive that keeps the carburetor clean has increased automobile mileage by almost 7 percent. The company also has developed a cleaning agent for furnace oils, which not only keeps the burners clean, it prevents internal corrosion.

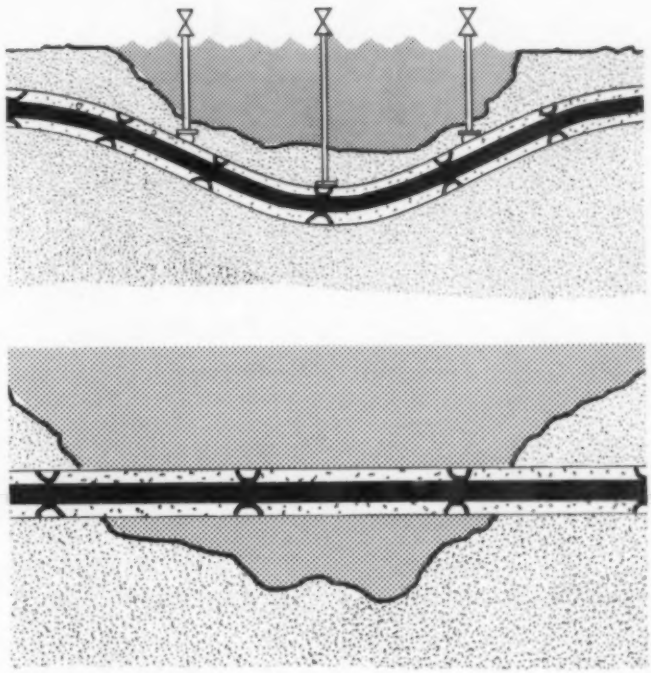
New method of underwater crossings may minimize ditching

A Houston engineering firm, Clear Span Engineering Co., developer of aerial river spans widely used in the pipe line industry, has designed a new method of underwater crossings to compete with its bridges. The new method, says Weldon Appelt, president of the company, will eliminate one of the major causes of underwater failures—fatigue induced by vibratory movement of unsupported spans across scours. In addition, the method will greatly reduce the cost of dredging.

Here's the way it works. A large diameter, light-gage casing is pulled across the bottom of the river in a shallow ditch. The casing is open-ended and fills with water as it goes.

Next, the pipe line is pulled through the casing, supported by centralizers spaced every 20 feet or so. Once in place, the entire casing is filled with concrete grout, pumped from the ends and through risers spaced along the casing.

The result would be a heavily reinforced concrete sheath, too heavy and too stiff to respond to any likely vibratory systems caused by the water flowing across an unsupported span. Sounds like a good idea—will it work?



Rules of Thumb

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Miscellaneous

—45—How Much Wire Rope Will Go On A Drum?

The following formula gives a close approximation of the length of wire rope which can be spooled onto a drum:

$$L = \frac{w \times h}{4D^2c} \cdot (D_d + h)$$

where

- L = the length of the line which will fill the drum in feet
- h = the height of the wire rope on the drum when full
- D_d = diameter of the drum in inches
- w = width of the drum in inches
- D_c = diameter of the wire rope

Example:

Find the amount of new ½-inch wire rope which can be spooled onto a 14-inch drum 30 inches wide, with 26-inch flanges.

$$h = \frac{26-14}{2} = 6 \text{ inches}$$

$$L = \frac{30 \times 6}{4 \times ½ \times ½}(14 + 6) = \frac{180}{\frac{4}{4}}(20) = 3600 \text{ feet}$$

What if the line is ⅝-inch?

$$L = \frac{30 \times 6}{4 \cdot ⅝ \cdot ⅝}(14 + 6) \qquad \frac{180}{\frac{25}{16}}(20) = 2304 \text{ feet}$$

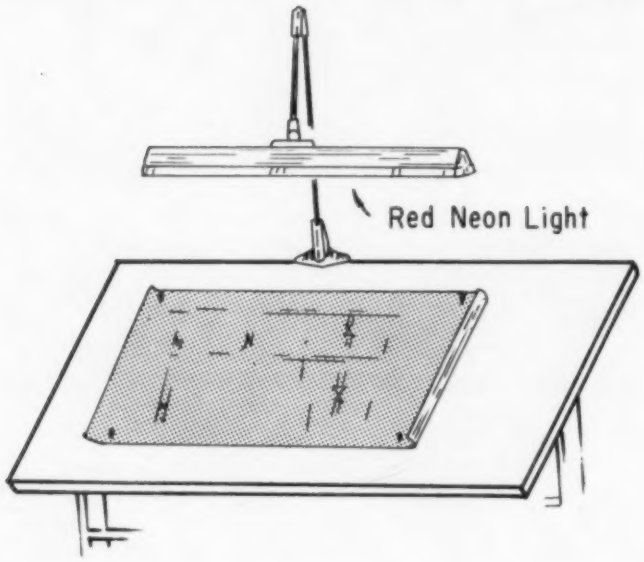
If the drum is used for hoisting, the diameter of the wire rope will increase with use. Deduct 15 percent for this "swelling."* The answers above should read 3,060 and 1958. This estimate is most accurate for cables near ½-inch diameter.

**Construction Methods and Machinery* by F. H. Kellogg, Prentice-Hall, Inc.

How to do it

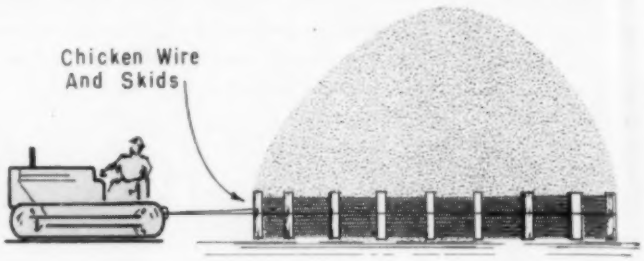
PIPE LINE HINTS

$10 is paid for each illustrated acceptable contribution. Mail to The Editor, PIPE LINE INDUSTRY, P. O. Box 2608, Houston 1, Texas



Red Light Makes Faded Blueprint Easy to Read

Sometimes it is necessary to carefully review old faded blueprints to make engineering evaluations of gathering systems, etc. In this case, a red light—preferably a red neon sign—will bring out the details of the faded blueprints. The red light darkens the blues but does not affect the white so far as visibility is concerned.



How to Skid Haystack Off the Right of Way

The old saying "and that ain't hay" implying that hay is cheap has long since become out of date. Because hay ain't *hay* anymore. *Hay* is money!

Here's one way of moving this valuable fodder off the right-of-way with minimum loss and contamination. (And less damages for the contractor.)

Take a turn around the stack with ordinary chicken wire. Pull it tight as possible and wire the ends together. Then run the line from a tractor or gin truck around it and skid it off the right-of-way.

Another method is to space skids about 3 feet apart, around the circumference of the stack, take a turn completely around the stack and skids from the truck or tractor and then move the stack. The pressure should keep the hay together. A combination of these two methods is best.

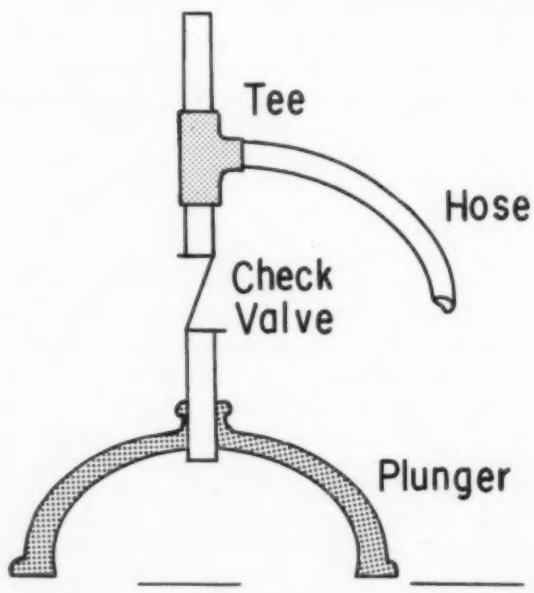
Make Inexpensive Pump From Plumbers Friend

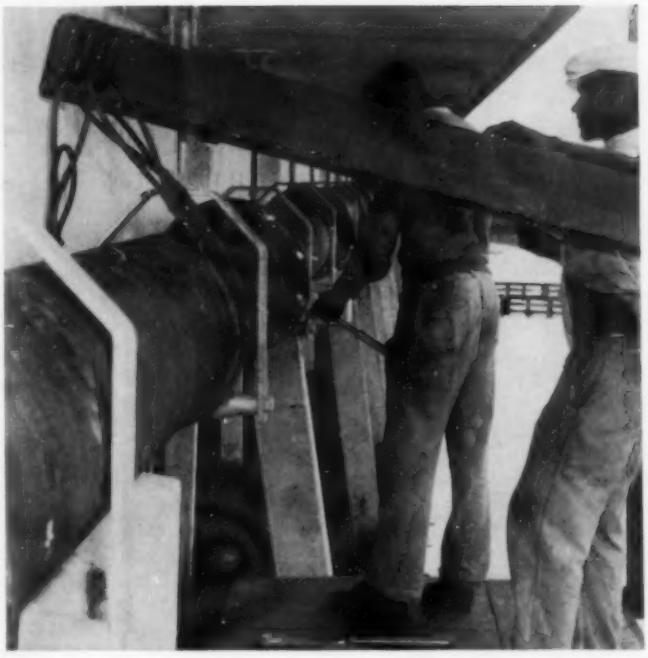
Here's a way to make an inexpensive pump that has many uses—ranging from pumping out boats, to removing fluids from a sump. There are several ways to make the pump, depending on its probable use, and the time that can be devoted to its fabrication. It's possible to make one in 10 minutes that will get by—others will take longer.

The key to this pump is the rubber suction plunger used for unstopping water closet fixtures. Remove the wooden handle, drill a hole into the cup as shown, fit a pipe nipple into the hole and cement it. Next, add a small check valve—a shop-made ball check will do—and then connect up a discharge hose.

To operate, simply plunge the pump up and down, keeping it immersed in the fluid. The pump will develop a surprising volume.

If no check valve is available, it is possible to use the thumb over the end of the hose instead. If the lift is not too high, it will work satisfactorily without a check valve by squirting the fluid clear of the discharge pipe each time.



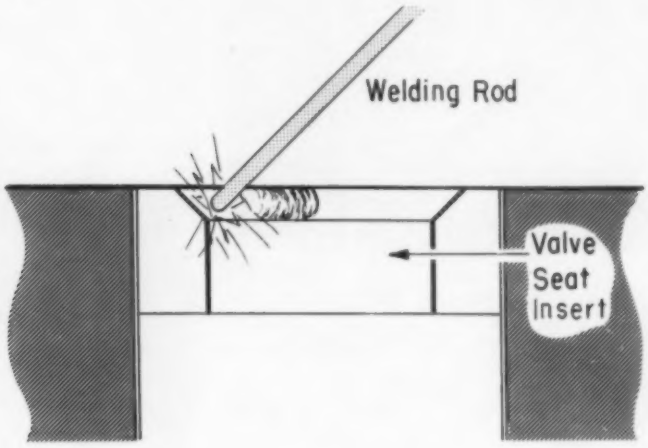


Work Platform Rides Underside of Bridge

A framework made of angle iron provides a platform for pipeliners engaged in lying a line on the underside of a bridge in Florida. The platform is counterbalanced by bags of sand which ride on the rubber-tired dolly which supports the assembly, as it is moved along the bridge to keep pace with the pipelaying.

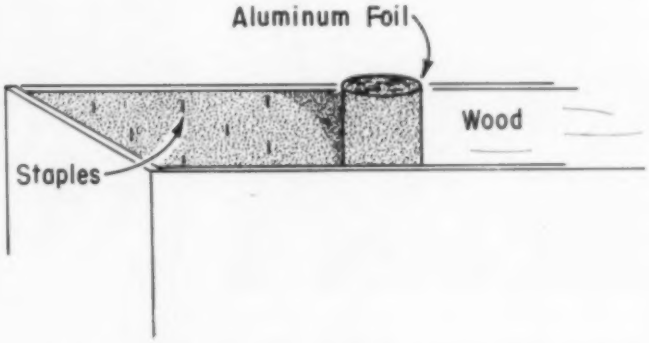
For convenience, the contractor provided his workmen with two platforms, one for each end of a joint of pipe.

When men are on the platform underneath the bridge, it rests against the bents which support the bridge. But when the men climb off to the bridge above, the platform swings free, and the assembly can be easily rolled to its next position.



How to Remove Valve Inserts from Engine

One way to remove heat-shrunk fittings from the engine block is to run a welding bead around one end of the fitting. The shrinkage is usually sufficient to make the fitting come clear. For example, where valve-seat inserts cannot be budged, run a hot bead around the bevel of the insert, being careful to avoid contact with the block itself. As the hot weld metal cools it draws in on the insert, loosening it as a rule.



Aluminum Foil Lining Protects Concrete Forms

Line concrete forms with aluminum foil to protect the wood against the burning action of the concrete and its chemicals, and at the same time, provide a better finish for the concrete.

All you need is sufficient rolls of aluminum foil to cover the inside of the forms and a stapler. Smooth the foil as you unroll it and staple it to the wooden forms. After the pour, the wood will be unaffected by the concrete and the concrete will have a smoother finish. This practice eliminates the need of form oil; the concrete will part at the aluminum foil.

Here's a Simple Way To Keep the Gate Open

The post of two-inch pipe is not off plumb by chance. It was deliberately installed that way so it could be used to hold open the large gate at a field compressor station in Central Texas. In the upper end of the two-inch pipe you see a smooth "hairpin" made of ⅝-inch round steel. This is the latch.

When you swing open the gate, simply lift the "hairpin" and drop one end over the gate. (The other end remains in the two-inch.)

Weld Engine Numbers on Engine Part in Basement

It only takes a minute or so to weld the engine number on the flange to the scavanging air piping clean-out flange in the compressor building basement as shown. What is the advantage? In a building where there are 10 engines or so, it eliminates the need to count the engine numbers in order to ascertain which one to start working on in the basement. Thus, if engine number six needs repairs to the lube oil cooler, simply look for the number "6" and start work.

Pipeliners Can Bicycle Across this Cattle Guard

Ever stop to think just what we accomplish with the padlocks and elaborate gates we install in the field. Just who do we lock out?

Cows—that's who!

We have few human-proof fences and gates. So in reality we are protecting our meter runs and pumps, etc., from cows—so why not design our

installations for these gentle critters.

A turnstile is good as a gate if it is cow proof, and so is a cattle guard.

Here's one company whose engineers are deferred to the bovine stature in adding this runner across a cattle guard. By keeping it close to the rail, they discourage old Sookie and Bessie and all but the most athletic cows—you know, the kind that can walk chalk lines.

Mount a Can of Ant Poison on Lawn Mower

Who is most likely to spot ant beds about the station yard?

Naturally, it's the man who mows the grass.

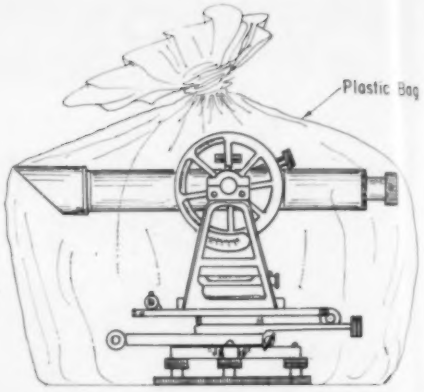
The only trouble, this man is likely to be somewhat remiss in going back and poisoning the beds of ants he sees.

One way to improve the efficiency of ant extermination is to mount a can of ant poison on the mower. Then when he spots ant beds, the yard man can poison the rascals on the spot.

Care should be taken to clearly label the can. Be sure to remove all previous markings and colors if an otherwise familiar can is used.

Plastic Bag Protects Your Transit From Dust

Here's one way to protect expensive transits and theodolites. When you are working in the dust country



—this includes virtually every pipe line job when the weather is dry—you can keep dust and dirt from getting to your transit by placing it inside the inexpensive plastic bags you get from your cleaners before placing the instrument inside its carrying case. After several uses, these bags will spring holes and tear—but if your instrument man is a single buck who sports around at night, his volume of cleaning and pressing will assure you plenty of cleaning bags.

IMPORTANT WARNING TO PARTY CHIEFS! Do not let your men place these bags over their heads unless you have his replacement handy. They're dangerous!

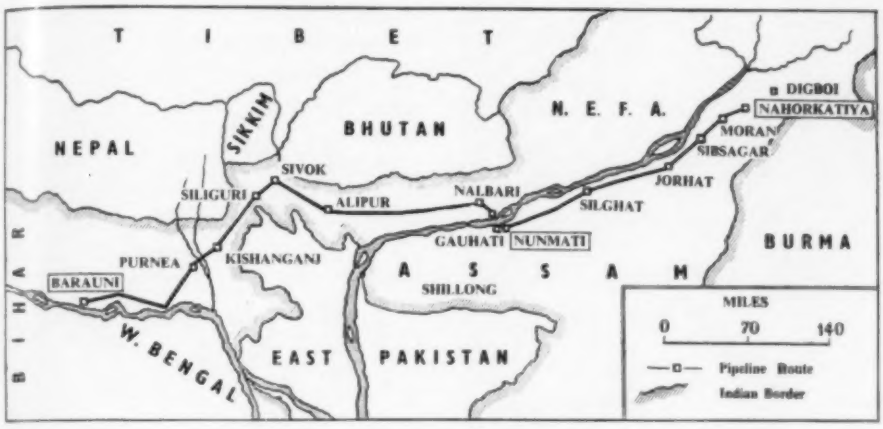
Tank Truck Has Volume Table Attached to Fender

The volume table of a tank truck —or for that matter any other tank— can be mounted under plastic to form a handy reference. The table can be typed, or printed. It is then glued to the truck as shown, and given a coat of clear lacquer.

A thin sheet of clear plastic is bolted over the table immediately after a second coat of lacquer. This prevents water from penetrating beneath the plastic.

WHAT'S HAPPENING IN PIPE LINE CONSTRUCTION

By **Donald G. DePugh,** Construction Editor



Route of India's crude line

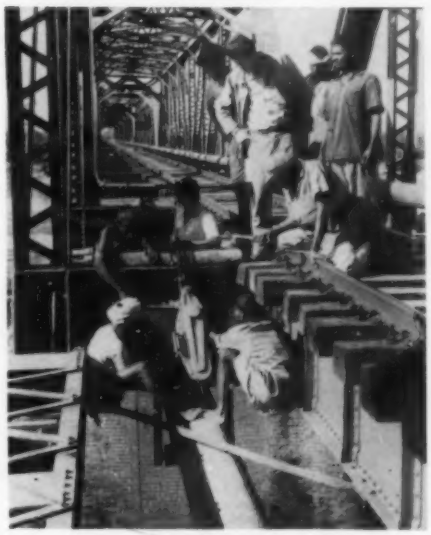
Work Begins on Big India Crude Line With Completion Set for November

Construction on India's largest crude line has begun with three spreads working on the first stage of the project which is scheduled for completion in November of this year.

The 720-mile, 14-16-inch system will extend from Nahorkatiya in Upper Assam to Barauni in Bihar. Oil India Private Limited, a joint venture between the Indian Government and Burmah Oil Company Limited, will complete the 270-mile, 16-inch section from Nahorkatiya to Nunmati in Assam.

Mannesmann-Saipemm Pipe Line Contractors, formed by German and Italian companies, will meet extreme terrain difficulties in laying the line. The line passes through rice fields, tea gardens, forests, hills and swamps in addition to crossing 78 rivers, one of which is the difficult River Brahmaputra. A one-mile overhead suspension bridge across the Brahmapurta is planned.

The $90 million project includes eight pump stations at intervals of approximately 90 miles. Stations will be remotely controlled from Gauhati, where the operator will operate stations and valves. Pump stations at Nahorkatiya and Moran will be gas driven reciprocating units. All other stations will use crude oil from the pipe line. At each station, three pumps will be installed.



Crossing the Burhi Dihing River in Upper Assam.

The second stage of the system, 460 miles, 14-inch, will be laid in 1962. The line will deliver crude to refineries in Nunmati and Barauni. Initial capacity will be 2.7 million tons per annum at Nunmati and 2 million tons at Barauni.

Peoples Plans Gas Line To Mahomet Storage Area

Peoples Gas Light and Coke Company is laying a 7½-mile, 12-inch temporary gas line to permit testing of a proposed underground natural gas storage facility in the Mahomet, Ill., area.

The line will carry gas from Natural Gas Pipeline Company's system to the storage area. Smaller lines will be installed to link the main line with wells drilled last year during preliminary exploration work. Storage rights have been purchased for all of the land in the 5,000-acre primary test area except for a small tract near the southern edge. If tests prove successful, Peoples will seek Illinois Commerce Commission approval to develop the reservoir as an adjunct to its distribution system serving Chicago. This will bring about construction of compressor facilities and a pipe line to Chicago area.

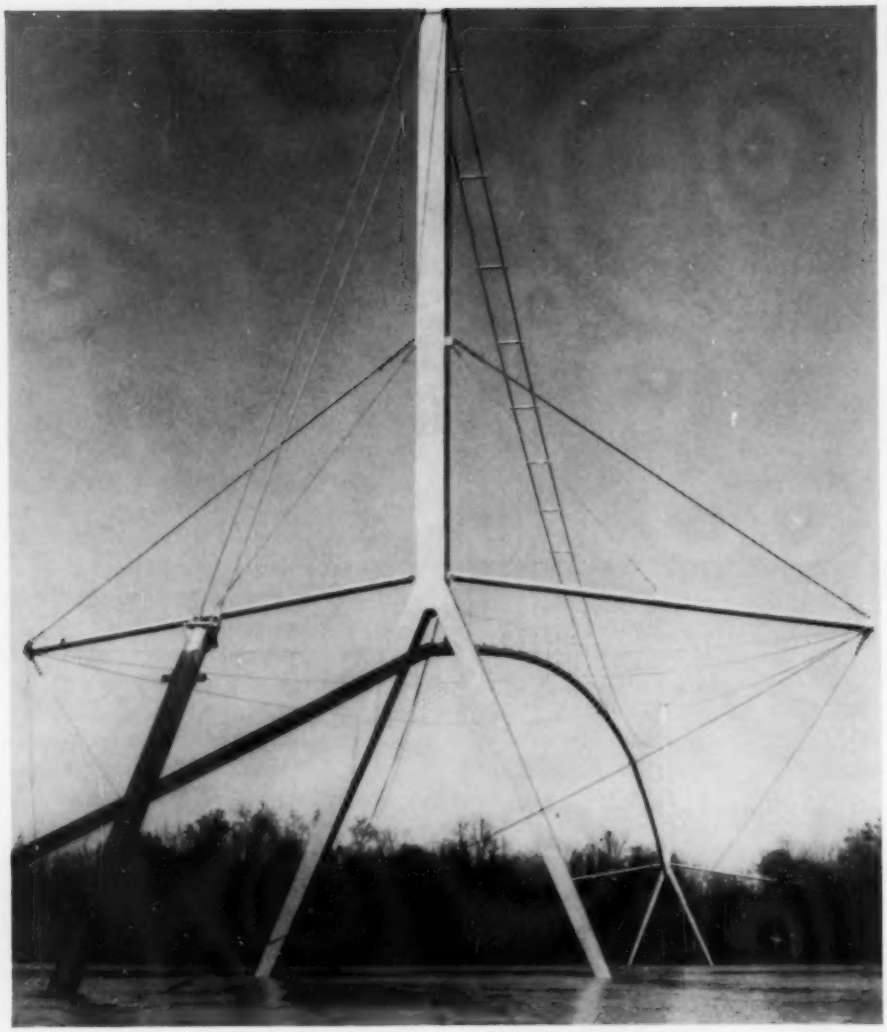
Northern Natural Seeks Expanded Use of Field

Northern Natural Gas Company is asking the Federal Power Commission for authorization for withdrawals of 95 MMcf of gas daily from its storage field near Redfield, Iowa.

The request is an amendment to a previously filed application seeking permission for 40 MMcf withdrawal. Northern also asked the commission for approval to install a 1,500 horsepower compressor unit at Redfield and increase the presently authorized inventory of gas in the Mt. Simon reservoir from 45 billion to 56 billion cubic feet. Northern is taking 100 MMcf per day from St. Peter-Elgin and Mt. Simon reservoirs of the storage field and seeks to raise that total to 195 MMcf.

Interstate Oil Pipe Line To Design West Shore Line

Interstate Oil Pipe Line Company has been authorized to supervise design, engineering and construction on West Shore Pipe Line Company's proposed 285-mile products pipe line



Pipe Line Bridge

No sooner had Arkansas-Louisiana Gas Company's aerial pipe line bridge been completed than the White River swelled to flood stage. This crossing near Crocketts' Bluff, 17 miles east of Stuttgart, Ark., is part of Ark-la's "T"-Line which runs from the company's Perla Station near Malvern to Helena, Ark. There it will deliver 65 MMcf of gas per day to Arkansas Power and Light Co.'s generating plant.

Distance between the two towers is 623 feet, and at the middle of the stream the 18-inch, ½-inch wall pipe swings 55 feet above the all-time high water mark. The two overhead cables are 1½-inch and the galvanized suspender cables are ½-inch. Tower height is 127 feet and the legs are 45 feet above the ground elevation. The bridge was installed by Rio Overhead Construction Co. It was designed and pre-fabricated by Clear Span Engineering Co. of Houston.

from the Chicago area to points in Illinois and Wisconsin.

Construction is scheduled to start in June and completion set for late 1961. The system will consist of a 16-inch line from Chicago through Des Plaines, Ill., to a terminal west of Milwaukee, Wis. From there a 16-inch lateral extends eastward to Jones Island in the Milwaukee harbor area where six petroleum terminals are located. A 10-inch line will run from Milwaukee to Green Bay, Wis.

Stations will be located at Bell, near Chicago, and at the terminal west of Milwaukee. Receiving points with meters and pumping facilities will be stationed at Hammond, Blue Island and Romeoville, Ill.

Texas Eastern Awards Contract to H. C. Price

Texas Eastern Transmission Corporation has awarded a contract to H. C. Price Company for 23 miles of 36-inch and 3 miles of 30-inch gas pipe line.

Price will construct the 3-mile section from the east bank of the Delaware River to near Lambertville, N.J., where Texas Eastern station number 26 will be located.

The 23-mile segment will be laid from the station to the west bank of the Raitan River, near New Brunswick. Construction is scheduled to start this month.

Westalta-Foothills Line To Be Canadian Controlled

George V. Meyers, Standard Oil Company (Indiana), executive vice president and James A. Scott, president of Pembina Pipe Line Ltd. have informed the Alberta Oil & Gas Conservation Board that the proposed Westalta Products Pipe Line Ltd., and Foothills Pipe Lines Ltd., will be Canadian controlled.

Westalta plans a liquid gathering system in Alberta, and Foothills plans a main line from Canada to the Chicago area. Standard recently announced plans to join Pembina in building the international system. Four directors of Westalta and Foothills will be designated by Pembina and four by Standard. The ninth director will be an independent Canadian citizen to be selected by both companies.

The board is studying the Westalta-Foothills proposals along with competing proposals.

Rocky Mountain Lays Line over Grand Mesa

Rocky Mountain Natural Gas Company has completed its gas pipe line project which extends through the Grand Mesa National Forest and passes over the top of the Grand Mesa at an altitude of 10,500 feet, highest flattop mountain in the world.

Forty miles of 8-inch lightwall pipe was used on the line.

FPC Hearings Underway On NGPL $52 Million Plan

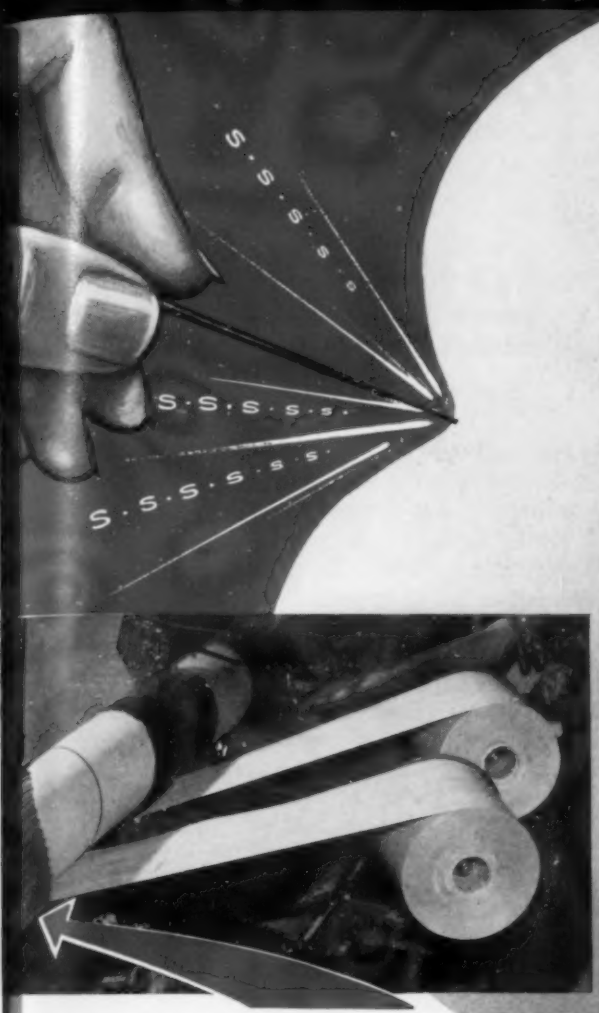
The FPC hearings on Natural Gas Pipeline Company's two applications proposing a $52 million construction project are underway.

NGPL is seeking permission to construct 285 miles of 30-inch loops; 60 miles of 36-inch loops; about 22 miles, 8-inch lateral and 64,200 additional compressor horsepower in Illinois, Texas, Arkansas, Kansas, Nebraska, Iowa and Missouri.

The facilities would increase the company's daily capacity of its Natural Division to 870 MMcf and of its Gulf Coast Division to 729 MMcf of gas. Additional capacity would be used to increase sales to 17 existing customers in Illinois, Indiana, Iowa, Wisconsin and Oklahoma.

The FPC also consolidated applications of producers proposing to sell to NGPL—Texaco Seaboard Inc., and Humble Oil & Refining Company.

Pinholes are fatal in pipe protection, too!



Electrical Inspection (arrow) is provided during processing of pipe. This automatically inspects the coating as it is applied, and guards against all "holidays" in the protection.

Pipe Line Service Methods eliminate costly failures of hit-or-miss pipe coating

Electrical Inspection is another PLS control for unvarying quality. This steel mesh screen, designed by PLS Engineers, is charged with thousands of volts. Every square inch of coated pipe passes under this screen and is electrically tested. When voids or holidays in the coating do occur, they are immediately detected and properly repaired. Scientific thoroughness by PLS provides you with uniform protection on every pipe length. Get full details from the Pipe Line Service sales office nearest you.

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Quality *costs less* in the long run!

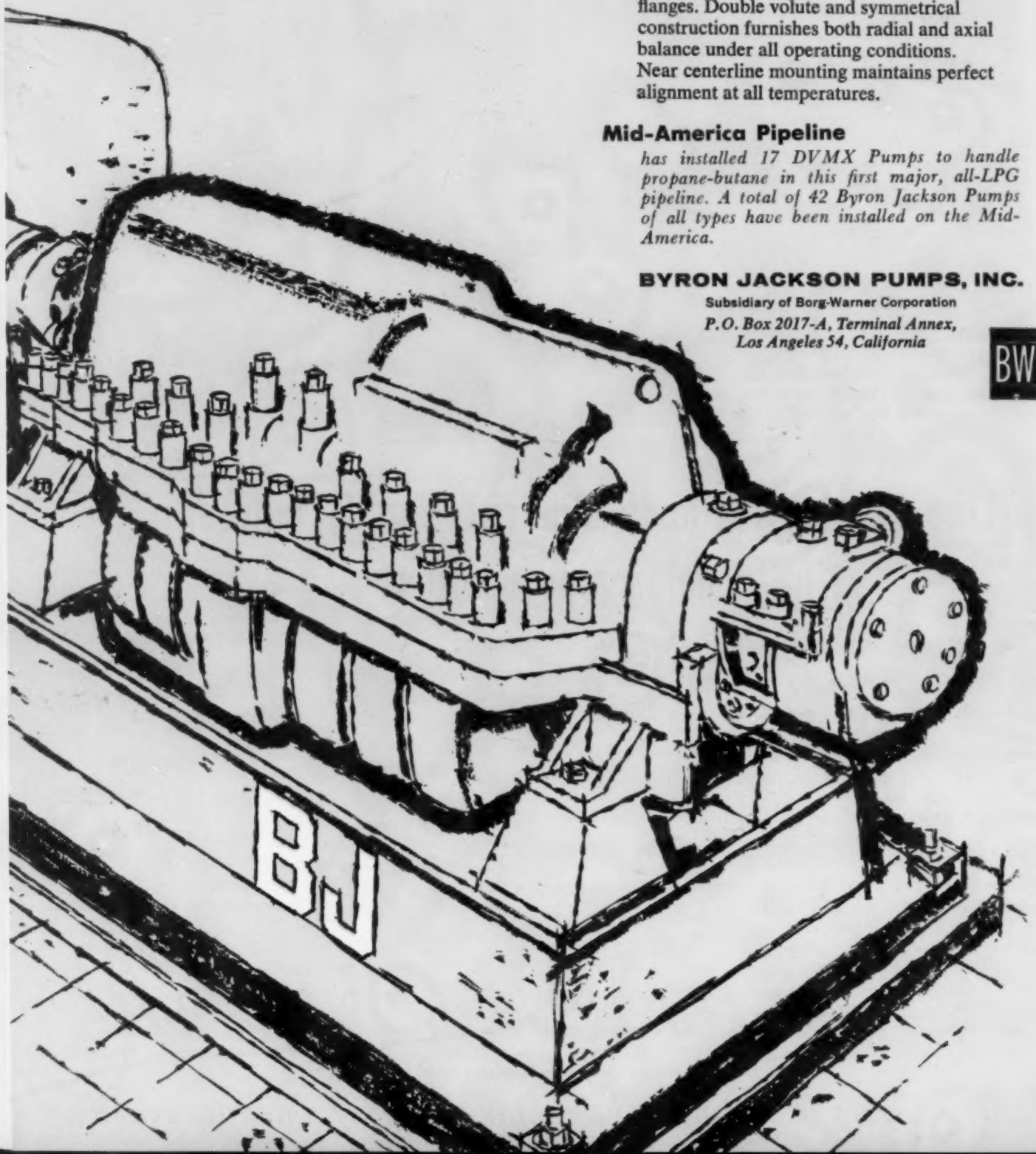
BJ Pipeline Pumps

For high pressure, high temperature and high speed pumping, an extra safety factor is built into this DVMX Pump—*the safety of a quality product!*

Clean and compact, BJ's advanced design allows double-row bolting to prevent interstage leaking or bowing at the parting flanges. Double volute and symmetrical construction furnishes both radial and axial balance under all operating conditions. Near centerline mounting maintains perfect alignment at all temperatures.

Mid-America Pipeline

has installed 17 DVMX Pumps to handle propane-butane in this first major, all-LPG pipeline. A total of 42 Byron Jackson Pumps of all types have been installed on the Mid-America.



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Peoples Laying Main Gas Line In Chicago

Work is underway on an 11-mile, 36-inch, gas main line for Peoples Gas Light & Coke Company for its distribution system in Chicago. Contracting & Material Company is laying the $9 million southern section of Peoples $20 million interstation gas main.

Last year 8 miles of line in the northern section was completed and in 1962 these two lines will be connected.

Mid-America Pipeline Plans Extension Lines

Mid-America Pipeline Company plans to construct two branch extensions from its liquefied petroleum gas line to serve Iowa markets.

The $4.5 million project includes a 106-mile, 6-inch line from Whiting to Ogden, Iowa, and a 100-mile branch from Ogden City to Charles City, Iowa. The Whiting-Ogden line will be laid this year and the other section is planned for 1962.

Northern Natural Receives FPC Examiner Authorization

An FPC examiner, Samuel Binder, authorized Northern Natural Gas Company to construct over 380 miles of pipe lines and 20,660 compressor horsepower. The decision is subject to review by the commission.

The decision includes authorization to sell 75 MMcf of gas daily to Michigan Wisconsin Pipe Line Company and Michigan Wisconsin was authorized to lay 88 miles of lines.

Northern's $37½-million program includes three projects. The company proposes to build about 50 miles of line and 2,000 horsepower to increase sales to existing customers. Also, Northern would lay 99 miles of pipe and install 4,660 horsepower for pipe line and storage facilities. The final section includes 233 miles of new lines and 14,000 horsepower costing $23 million to supply Michigan Wisconsin in the Janesville, Wis., area.

Michigan Wisconsin's construction would consist of 88 miles of line and 3,000 horsepower. The new line would include an extension to Barbaroo, Wis.

In another application, Northern received examiner's approval to construct 11 miles, 30-inch loops; 63 miles, 16-inch and 5,400 horsepower at a cost of $6.2 million.

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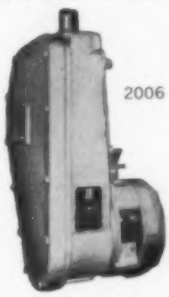
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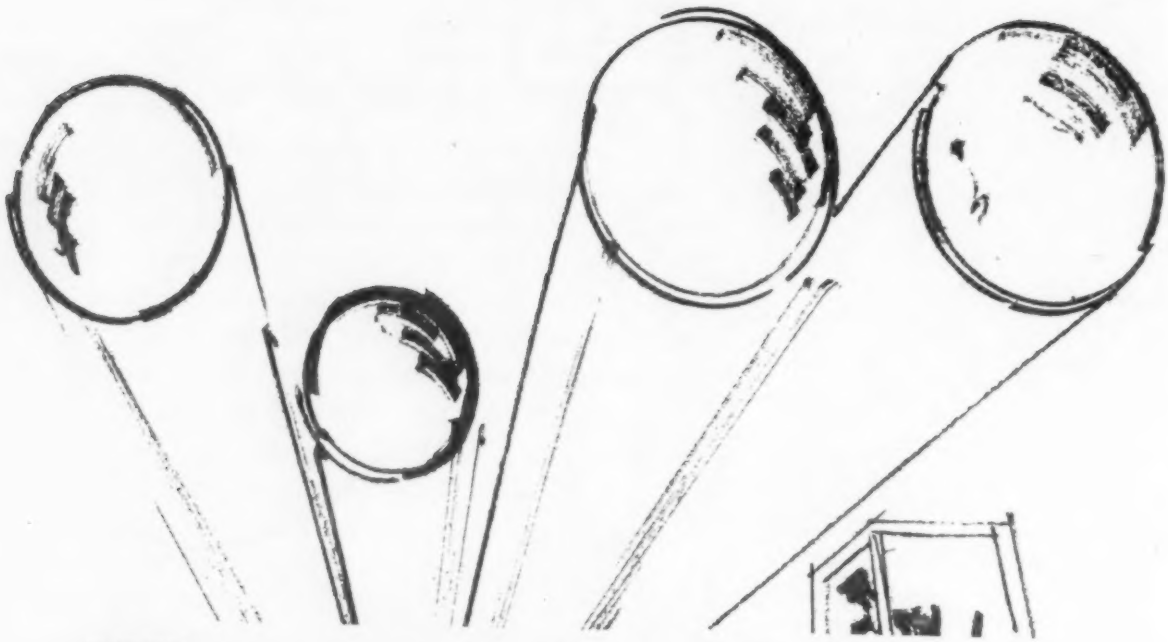
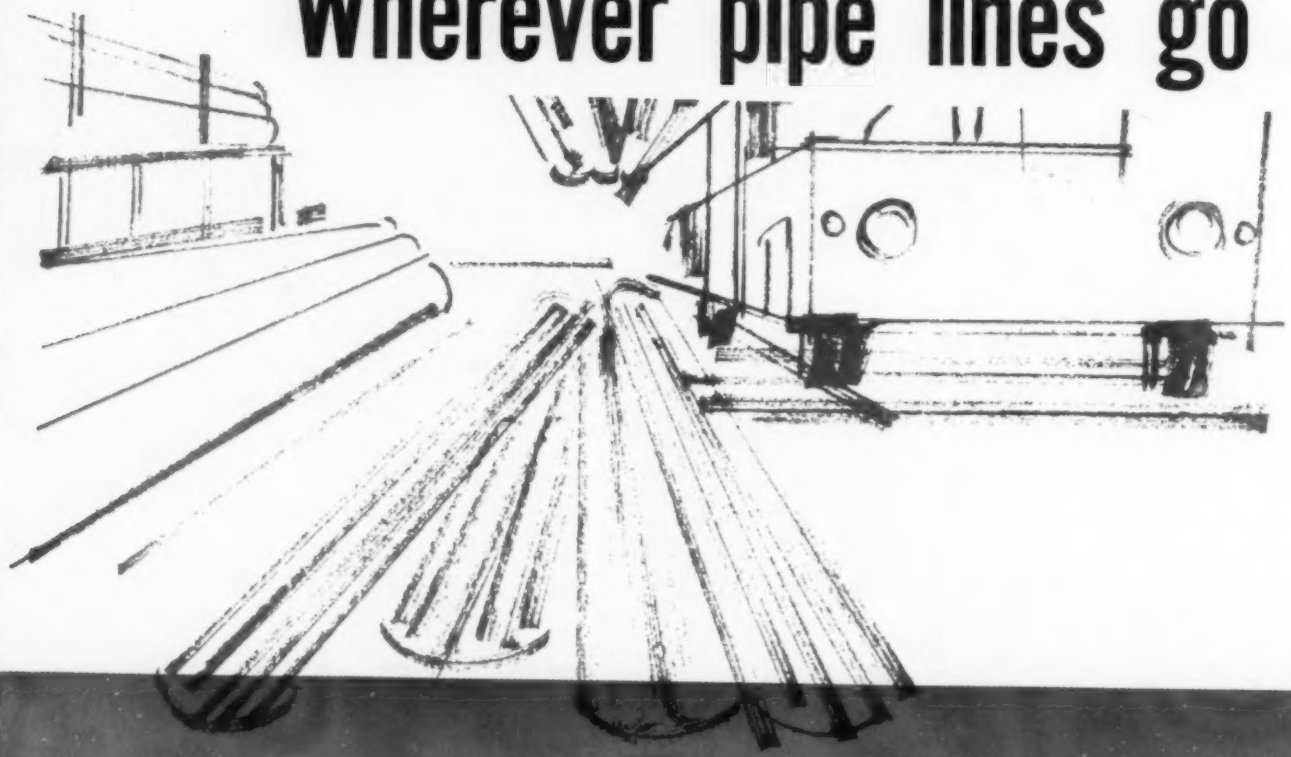


Wherever pipe lines go . . .



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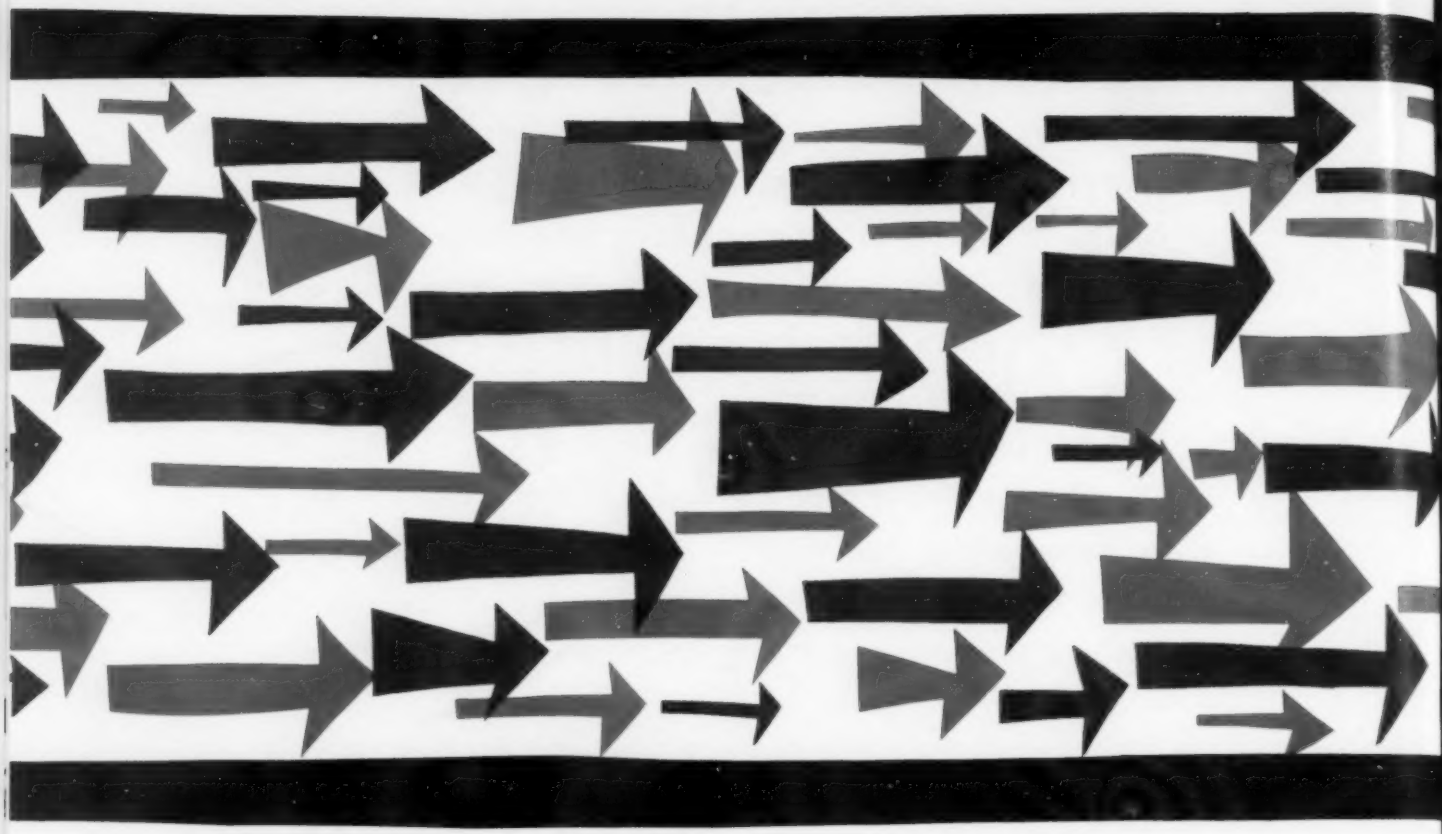

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Monterey Company Plans Houston-Alexandria Line

Monterey Gas Transmission Company, newly formed pipe line company of Humble Oil & Refining Company, plans to construct a 216-mile, 30-inch gas line from near Houston to Alexandria, La.

Monterey also will purchase Humble's existing 238-mile, 30-inch gas line which extends from Humble's King Ranch plant in Southwest Texas to Clear Lake near Houston, and purchase 6.2 trillion cubic feet of gas in-place in Southwest Texas from Humble.

The new transmission company would deliver gas to a Columbia Gas System, Inc., company which will enter into a long-term contract to purchase the gas. Monterey will ultimately carry 700 MMcf of gas daily for sale to United Fuel Gas Company, a Columbia Gas System Company. Columbia Gulf Transmission Company will transport the gas from Alexandria to the consuming area.

Initial shareholders of Monterey Gas are Humble Oil & Refining and Lehman Brothers, New York investment firm. The company plans to file with the FPC soon. Deliveries from Monterey to Columbia are scheduled to start late in 1962.

John R. McMillan, former executive vice president of Monterey Oil Company, is president of the new firm. Donlin P. Murdy, former vice president of Monterey Oil, will be vice president and treasurer.

Construction To Start Soon on Trans-Europe Line

Construction is scheduled to begin soon on the Marseille to Karlsruhe crude line. The 460-mile, 34-inch line will be built and operated by Societe du Pipe-Line Sud-European.

The line will have an initial capacity of 200,000 barrels per day. Plans include installation of three pump stations. Sixteen companies are involved in the project.

Monsanto Plans to Link Plants with Pipe Lines

Plans are being considered by Monsanto Chemical Company to lay a pipe line network from its Texas City petrochemical plant to a newly planned petrochemical complex between Alvin and Angleton, Texas.

The 20-mile system would include three lines carrying ethylene, propylene and various hydrocarbons.

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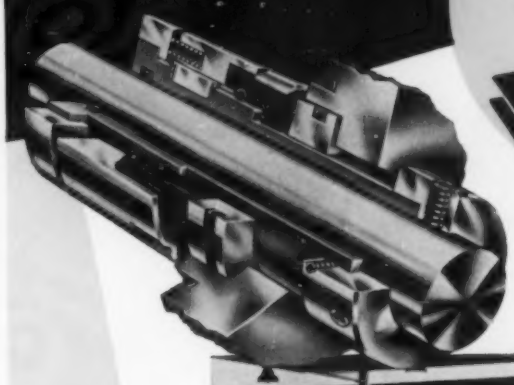
. . . and ANOTHER Pipe Line Company CONVERTS TO John Crane® 8-B SEALS



A COMPETITIVE FIELD TEST in which one half the pumps were equipped with JOHN CRANE 8-B Seals and the other half with various competitive seals was recently conducted by a leading pipe line company.

THE RESULT showed that in *every* case the JOHN CRANE 8-B Seals out-performed all other seals in the system both in positive sealing and length of service.

PROOF AGAIN that wherever service is tough and pressures are high, 8-B Seals successfully do the job.

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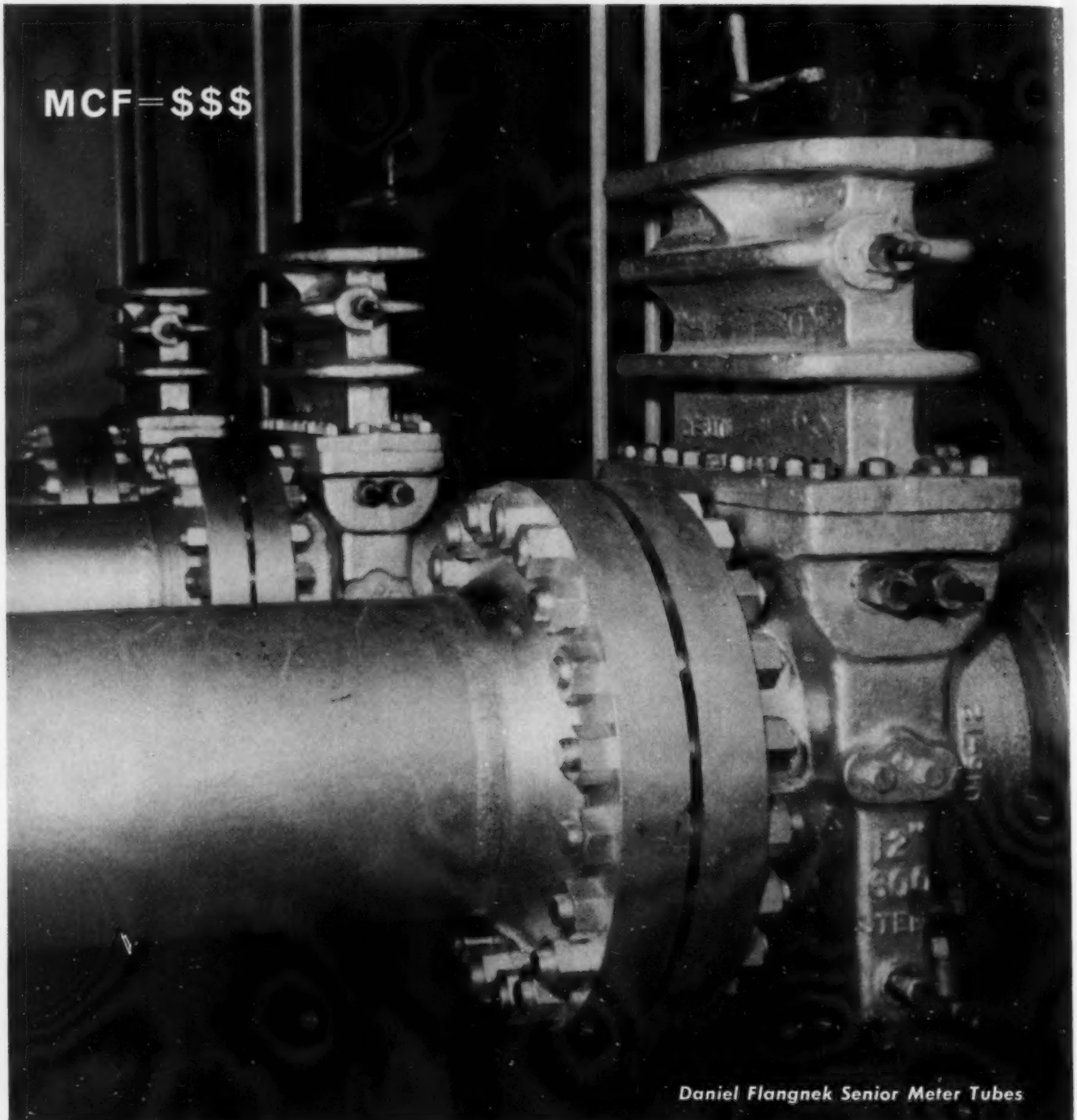

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Magnolia Completes Microwave Network

Magnolia Pipe Line Company has completed control system for its 540-mile crude line between Beaumont and Midland, Texas.

Construction on 12 microwave relay towers and stations on the 335-mile Corsicana to Midland section are nearing completion and the entire system will be remotely controlled from its Dallas office.

Ceremonies Mark Opening Of Transwestern System

Transwestern Pipeline Company offically proclaimed its $189 million completely automated gas system is in operation when it held dedication ceremonies at its push-button headquarters, Roswell, N.M., last month.

More than 200 people attended the dedication at the Roswell station where the entire 1,800-mile line with five centrifugal main line stations is controlled remotely. The station control center includes a panel which keeps the operator informed of every operating condition for the length of the line and an analog flow computer which simulates and solves pipe line flow problems.

A compressor analyzer can be used to predetermine operating conditions at the compressor stations before the stations are placed on the line. This computer also can be used to check efficiency of the compressor equipment.

Genoa to Aigle Line Gets Swiss Approval

Approval of the Genoa to Aigle, Switzerland, crude line has been given to SNAM, of ENI, Italy. The line is part of a network to connect Italian cities of Genoa-Milan- and Turin with Aigle. SNAM plans also to extend the line to Bavaria at Munich.

ERRATA

Two minor corrections should be made in "Deep Ground Beds Solve Congested Area Corrosion Problems" by Sidney E. Trouard and E. A. Wagner, Jr., March PIPE LINE INDUSTRY, Page 37. Equation (1) should read

$$(1)\ R_r = \frac{\rho}{2\pi}\int_{r_1}^{r}\frac{dr}{r^2} = \frac{\rho}{2\pi}\left(\frac{1}{r_1} - \frac{1}{r}\right)$$

Also, the Greek letter epsilon should be changed to rho in the definitions following then reading

ρ = soil resistivity in ohm centimeters.

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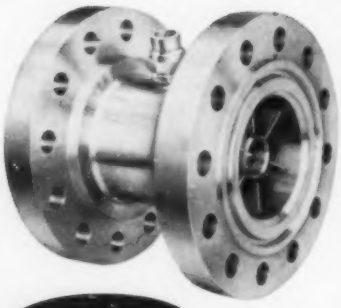
For more data on advertised products, use Readers' Service Cards, last page.

COX TURBINE FLOWMETERS



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Tampico to Brownsville Crude Pipe Line Considered

A 280-mile crude pipe line from Tampico, Mexico, to Brownsville, Texas, is being discussed by Petroleos Mexicanos officials and R. B. Kahle of a Houston marketing firm.

The Mexican portion of the $16 million line would be built and operated by Pemex; G & K Corp., of Houston, would build the section from the Rio Grande to Brownsville.

Gas Pipe Line In Germany Planned

A 180-mile gas pipe line is planned in Germany. The $20 million proposal will extend southward from Mannheim to Kehl via Karlsruhe and eastward from Karlsruhe to Ulm.

The line will be built by Gasversorgung Sueddeutschland, a holding company formed by several Baden-Wuerttemberg cities.

Firms interested in bidding on the line should contact Director Juergen Stech, Technische Werke Stuttgart, West Germany, a member of the managing board to Gasversorgung.

Lone Star Begins Construction Work

Construction has begun on Lone Star Gas Company's 52-mile, 18-inch main line in West Central Texas. The line will be completed by Lone Star crews next month. It extends from the company's Springtown gasoline plant, near Fort Worth in a southwesterly direction across Parker and Palo Pinto counties to Gordon in Palo Pinto County. At Gordon it connects with a gasoline plant and the east end of an existing 12-inch line which terminates near the corner of Brown, Comanche and Eastland counties.

Techint Milano Laying Products System In Syria

Techint Compagnia Tecnica Internazionale is building a 300-mile 6-inch products pipe line system in Syria. The system will stretch from the refinery at Lattakia to Homs, from Homs to the depots of Damascus and Aleppo.

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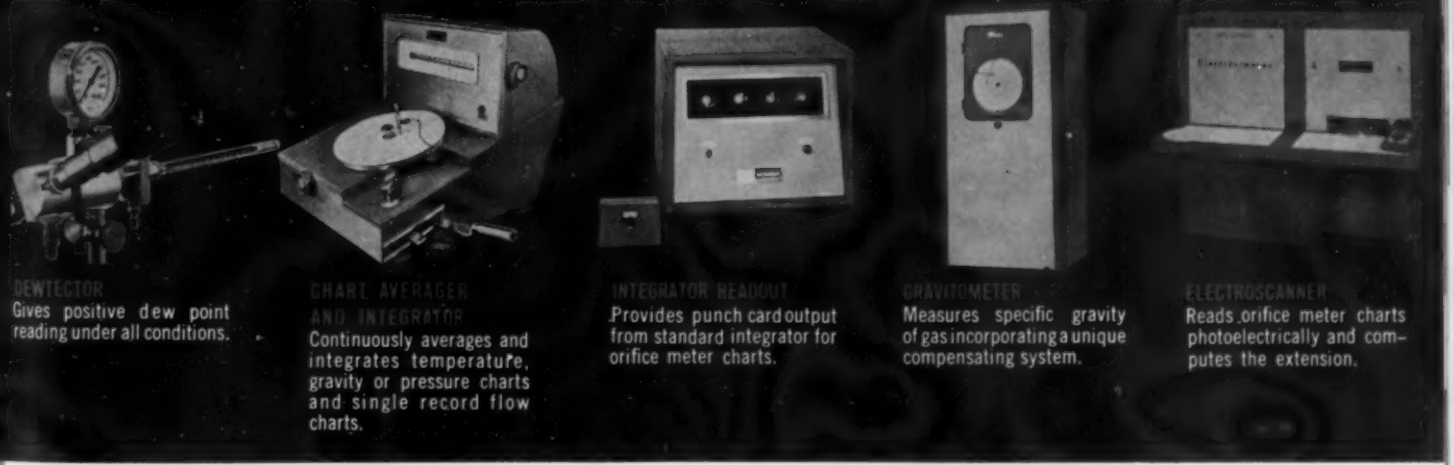

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PROPOSED PIPE LINE CONSTRUCTION

Here in convenient summary form is Pipe Line Industry's listing of company, line size, length, service, location and project status.

U.S.

Algonquin Gas Transmission Co., Boston, 25 miles, 20-inch; 8 miles, 8-inch, gas, and 12,000 hp addition in Massachusetts, $6 million, FPC Authorization.

Arkansas Louisiana Gas Company, Shreveport, La., 58 miles, 2-6-inch, gas, planned.

Border Gas Transmission Company, 300 to 400 miles, gas, gathering, in South Texas, $10 million, planned.

Buckeye Pipe Line Co., New York, 42 miles, 8-inch, products, Flint to Bay City, Mich., $1.7 million, planned.

California Gas Transmission Company, Los Angeles, (subsidiary of Tennessee Gas Transmission Company), 292 miles, 20-34-inch gas, from Mexico-California border near Mexicali, to Los Angeles and 10,000 hp. to tie into Texas Mexico-California line, $50 million, before FPC and California Public Utilities Commission.

Coastal States Gas Producing Co., Corpus Christi, Texas, 60 miles, 10-inch, gas, gathering, La Salle and Frio counties, Texas, before FPC.

60 miles, small diameter, gas gathering line, to tie in with system under construction and extend to Pearsall County, Texas, planned.

Coastal Transmission Corp., Houston, 71 miles, 3 to 10-inch, gas, laterals; 5,500 hp in stations at Port Lavaca, Texas, and Eunice, La., and additional 1,500 hp at Robstown, Texas, $7.2 million, FPC examiner authorization.

Colorado Interstate Gas Co., Colorado Springs, 140 miles, 34-inch, gas, Green River, Wyo.,-to-Provo, Utah; 109 miles, 26-inch, Texas Panhandle to southeastern Colorado, 136 miles, 34-inch, southeastern Colorado-to-Pueblo, Colo.; 107 miles, 30-inch, Pueblo-to-Denver, $91 million, FPC conditional authorization.

Colorado Oil & Gas Corp., Denver, 400 miles, gas, from Gubik field to Fairbanks, Alaska, planned.

Columbia Gulf Transmission Company, Houston, 97 miles, 30-inch, loops in Kentucky, Tennessee, Mississippi and Louisiana; 29 miles, 12-inch lateral in Louisiana, $15 million, before FPC.

Dixie Pipeline Company, Tulsa, 1,000 miles, LPG, Mont Belvieu, Texas, to North Carolina, $35 million, planned.

El Paso Gas Supply Company, El Paso, Texas, 228 miles, 30-inch, gas, main, Live Oak to Sutton County, Texas, $30 million, before FPC.

El Paso Natural Gas Company, El Paso, 199 miles, 30-inch, Permian-San Juan crossover loop, before FPC.

17 miles, from Pacific Gas Transmission Co. facilities to near Spokane, Wash., before FPC.

34 miles, 20-inch, Puckett to Goldsmith, before FPC.

23 miles, 20-inch, Goldsmith to Eunice-Plains line, before FPC.

9 miles, 20-inch, Goldsmith-Plains loop, before FPC.

43,600 hp in new and existing stations in Texas, Oklahoma, New Mexico and Utah, before FPC.

400 miles, 34-inch, Salt Lake City, Utah, to California border, FPC conditional authorization.

Continued on Page 92

SAVING TIME ... SAVES MONEY — SAVE BOTH WITH ..

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WEIGHT PLACEMENT

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What is the most important part of a pipe line pump?

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Wichita Falls, Texas—Pump Engineering Co.
Evansville, Indiana—Hague Equipment Co., Inc.
Long Beach and Bakersfield, Calif.—Power Pumps, Inc.
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PROPOSED CONSTRUCTION

continued

Equitable Gas Company, Pittsburgh, Pa., 31 miles, 16-inch, and 26 miles, 20-inch, in West Virginia and Pennsylvania, $5 million, before FPC.

Hope Natural Gas Company, Clarksburg, W. Va., 20 miles, 20-inch, gas, in Lewis, Ritchie and Pleasants counties, W. Va., $2 million, FPC authorization.

Houston Texas Gas & Oil Corp., St. Petersburg, Fla., 235 miles, 2 to 6-inch, gas, laterals; 20,000 hp in five new stations; $16 million, FPC examiner authorization.

Kansas-Nebraska Natural Gas Company, Hastings, Neb., 165 miles, 2-8-inch, gas, extension from Alliance, Neb., to Chadron, Crawford, Hemingford, Hay Springs, Gordon and Rushville, Neb., before FPC.

45 miles, 2-3-inch, gas, in Kansas, approved by Kansas Corporation Commission.

2,000 hp addition at Scott City, Kan., FPC approval authorization.

2,500 hp addition at Holcomb, Kan., before FPC.

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Lone Star Gas Company, Dallas, 52 miles, 18-inch, Springtown to Gordon, Texas, underway by Company crews.

47 miles, gathering lines in Palo Pinto, Erath and Stephens counties, Texas, planned.

Long Island Pipeline Company, New York, 75 miles, 20-inch, products, Linden, N. J., to Long Island, N. Y., $30 million, planned.

Lo-Vaca Gathering Co., 230 miles, 6-20-inch, gas, gathering, Live Oak to Lavaca County, Texas, planned.

Matador Pipe Line Corp., Denver, 175 miles, crude, from Bottineau, Burke and Renville counties, N. D., to Cromer, Man., Canada, $4 million, proposed.

Michigan Wisconsin Pipe Line Company, Detroit, 88 miles, gas, 3,000 hp, take gas from Northern Natural at Janesville, Wis., before FPC.

Mid-America Pipe Line Co., 405 miles, 10-inch, LPG, Superior, Wis., to Chicago, $12 million, considered.

106 miles, 6-inch, LPG, extension from Whiting to Ogden, Iowa, planned for 1961.

100 miles, LPG, extension from Ogden City, to Charles City, Iowa, planned for 1962.

Monterey Gas Transmission Company, Houston, 216 miles, 30-inch, gas, Clear Lake, Texas, to Alexandria, La., planned.

Natural Gas Pipeline Company, Chicago, 285 miles, 30-inch; 60 miles, 36-inch and 22 miles, 8-inch, gas, and 64,200 hp, in Illinois, Texas, Arkansas, Kansas, Nebraska, Iowa and Missouri, $52 million, before FPC.

New Haven Pipeline, Inc., products line, New Haven, Conn. to Springfield, Mass., $2.5 million, planned.

Niagara Mohawk Power Corp., 122 miles, 12-inch, Watertown and Massena, N. Y., contract let to Fulghum Contracting Corporation pending FPC approval.

Northern Natural Gas Company, Omaha, 50 miles, gas line, 2,000 hp, before FPC.

99 miles, gas, 4,660 hp, $8.9 million, before FPC.

233 miles, gas, 14,000 hp, to connect to Michigan Wisconsin system at Janesville, Wis., $23 million, before FPC.

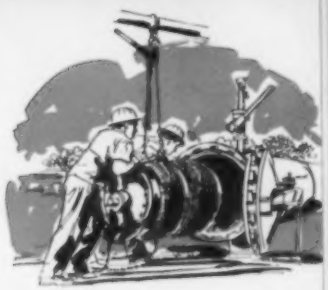
Northern Gas Products Co., (subsidiary of Northern Natural Gas Co.), 350 miles, 8-inch, LPG, Bushton, Kan., to Des Moines, Iowa, $12 million, planned.

Northwestern Refining Co., crude gathering system, Rival and Lignite fields, North Dakota, $625,000, Public Service Commission approval.

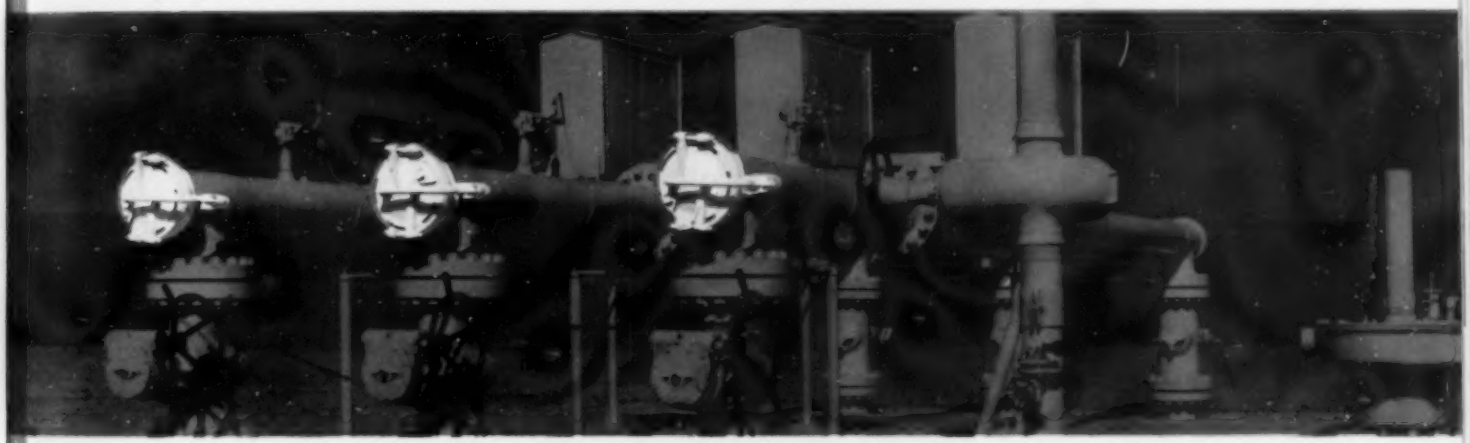
Ohio Fuel Gas Co., 59 miles, gas, 4-24-inch main lines, in Belmont, Carroll, Cuyahoga, Fairfield, Logan, Lorain, Marion, Muskingum, Stark and Wayne counties, Ohio, $5.1 million, planned.

Continued on Page 97

Read "between the pipelines"



UNIBOLT Hinged Closures started a new trend in pipeline scraper traps . . . greatly simplified the sending and receiving of pigs. Release only two bolts and this closure swings open and shut on a sturdy hinge. The self-sealing resilient gasket seldom, if ever, needs replacing.



These are UNIBOLT Hinged Closures on a gas pipeline meter manifold. They permit easy access to the meter runs for inspection and cleaning.

(Left) Gas pipeline blowoff head equipped with UNIBOLT Closures on a cantilever hinge for easy opening. A bleeder plug is provided for safely relieving pressure that may leak thru the riser valve. (Right) UNIBOLT Welding Neck Couplings in a products pipeline manifold. The cross-overs are equipped with a half-coupling which interchanges with blanking plugs on the risers. This arrangement eliminates many valves and insures against commingling of products.

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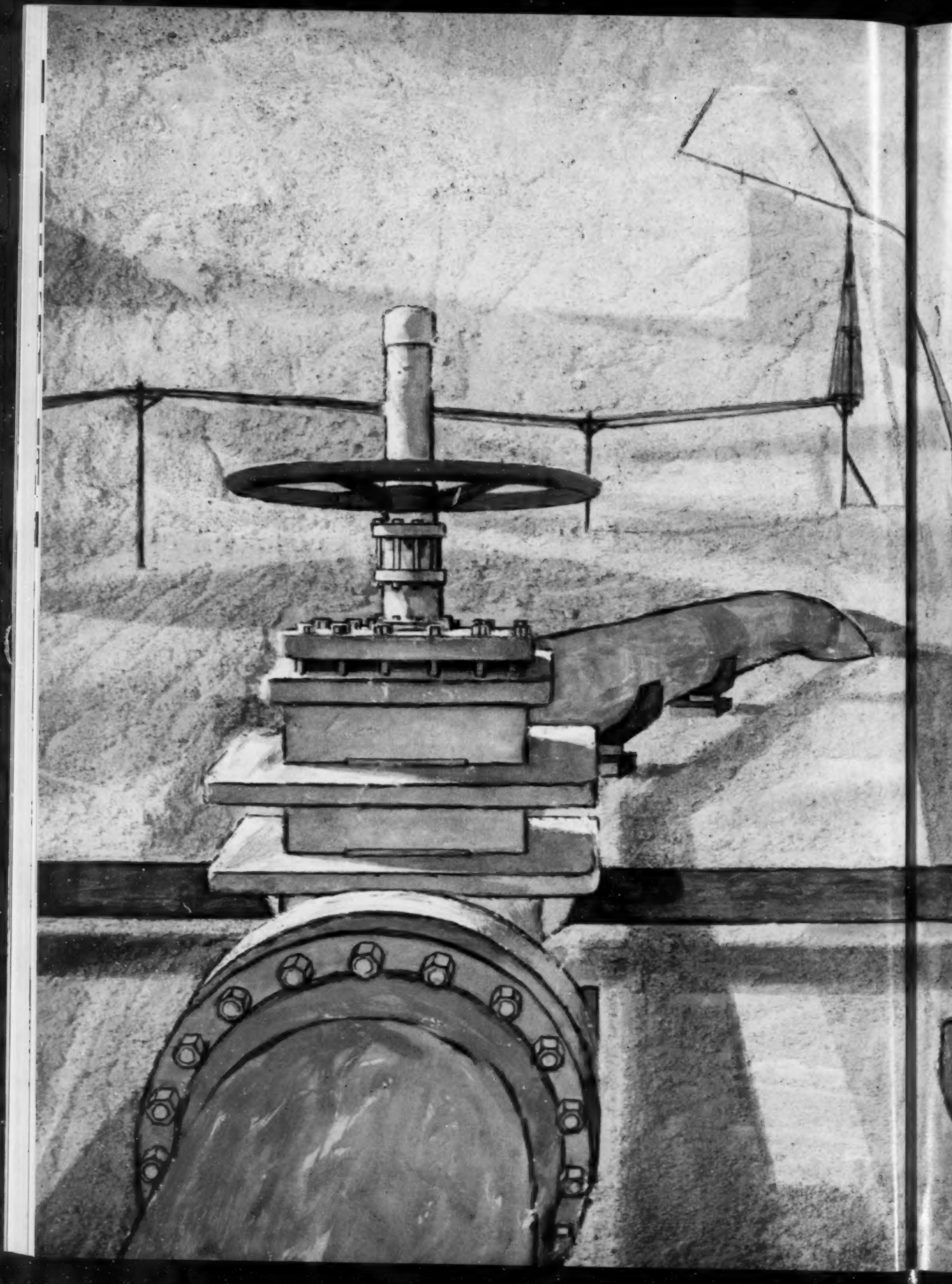

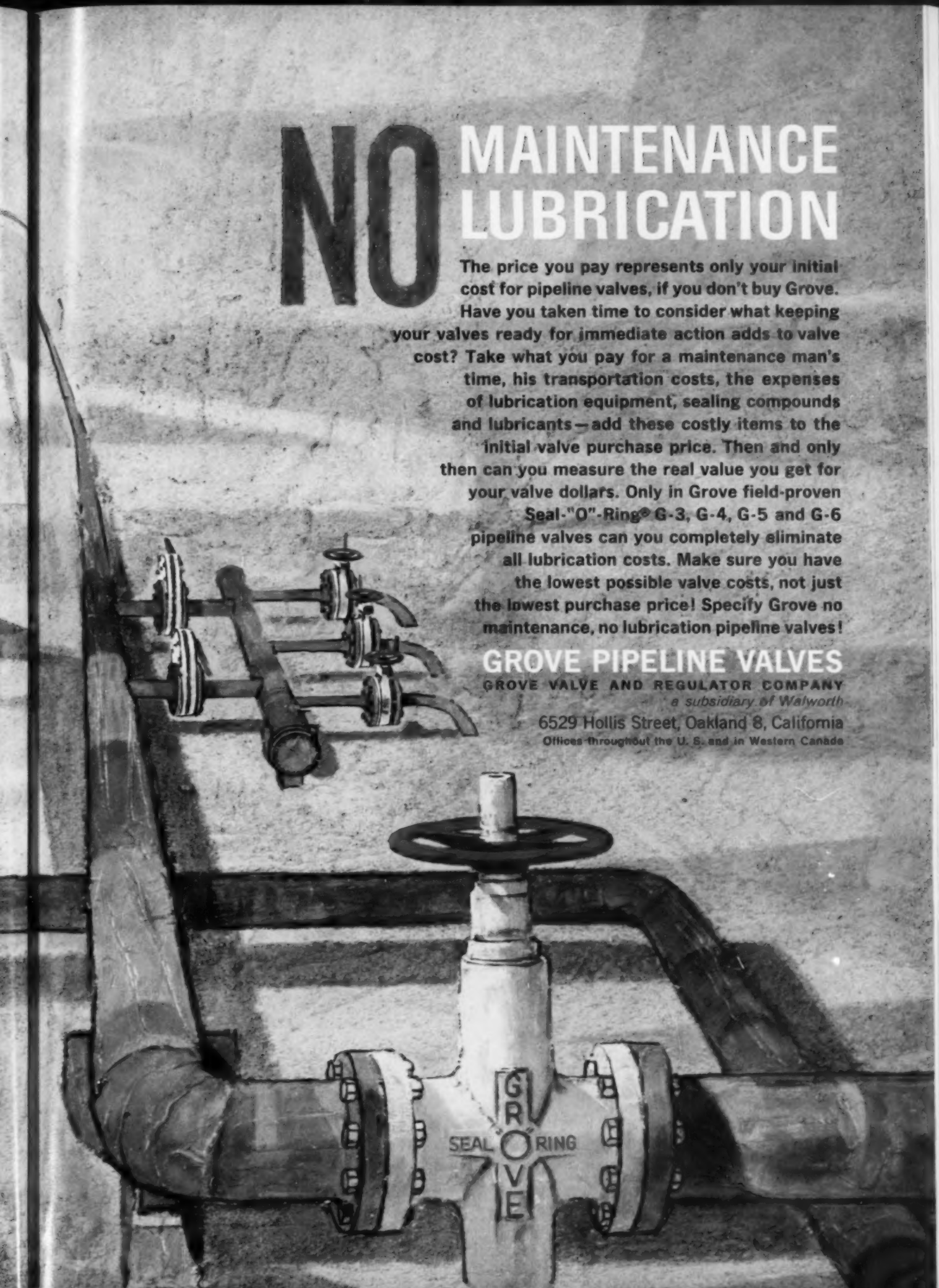
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The price you pay represents only your initial cost for pipeline valves, if you don't buy Grove. Have you taken time to consider what keeping your valves ready for immediate action adds to valve cost? Take what you pay for a maintenance man's time, his transportation costs, the expenses of lubrication equipment, sealing compounds and lubricants—add these costly items to the initial valve purchase price. Then and only then can you measure the real value you get for your valve dollars. Only in Grove field-proven Seal-"O"-Ring® G-3, G-4, G-5 and G-6 pipeline valves can you completely eliminate all lubrication costs. Make sure you have the lowest possible valve costs, not just the lowest purchase price! Specify Grove no maintenance, no lubrication pipeline valves!
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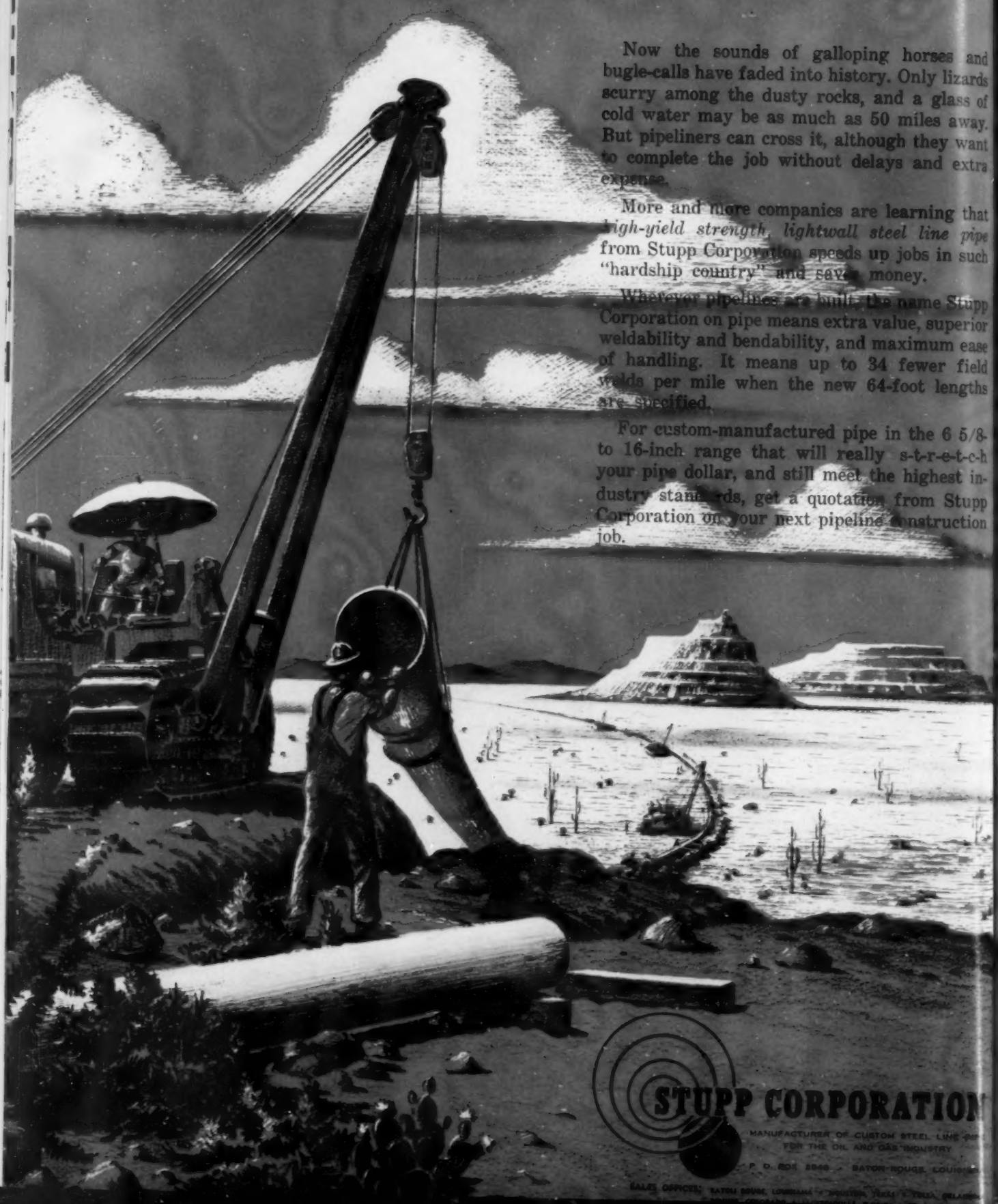

Now the sounds of galloping horses and bugle-calls have faded into history. Only lizards scurry among the dusty rocks, and a glass of cold water may be as much as 50 miles away. But pipeliners can cross it, although they want to complete the job without delays and extra expense.

More and more companies are learning that *high-yield strength, lightwall steel line pipe* from Stupp Corporation speeds up jobs in such "hardship country" and saves money.

Wherever pipelines are built, the name Stupp Corporation on pipe means extra value, superior weldability and bendability, and maximum ease of handling. It means up to 34 fewer field welds per mile when the new 64-foot lengths are specified.

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PROPOSED CONSTRUCTION

continued

Panhandle Eastern Pipe Line Co., Kansas City, 305 miles, 30-inch, 40 miles, 26-inch, gas, loops, and 43,000 hp, and gathering facilities, $60 million, before FPC.

200 miles, 22-24-inch, gas, lateral, from Elk City, Okla., to Haven, Kan., $15. million, before FPC.

Phillips Pipe Line Co., Bartlesville, Okla., 75 miles, main line, 85 miles, gathering crude, from Camrick field, Gray, Okla., to Phillips, Texas, planned.

Southern California and Southern Counties Gas Cos., Los Angeles, 93 miles, 34-inch, California-Nevada border to Newberry, Calif.

St. Lawrence Gas Company, Inc., Ogdensburg, N. Y., 75 miles, gas, main, United States-Canadian border to Ogdensburg, N. Y., $3.4 million, FPC examiner approval.

SunOlin Chemical Company, Philadelphia, 6,000 feet, ethylene line, under Delaware River, Claymont, Penn., to Penns Grove, N. J., $2 million, planned.

Tennessee California Gas Transmission Company, (subsidiary of Tennessee Gas Transmission Co.), 100 miles, 26-inch, gas, gas fields in South Texas to Texas-Mexico border near Reynosa, before FPC.

Tennessee Gas Pipeline Co., Houston 191 miles, 30 and 36-inch loops, in Ohio, Pennsylvania and New York, 72 miles of gathering lines and 43,600 hp in five stations, $46 million before FPC.

158 miles, 36-inch, gas, loops in Mississippi and Louisiana, FPC authorization.

21 miles, 16-inch, 2 miles, 12-inch, gas, Louisiana coast, Vermilion blocks 46 and 64, $3 million, before FPC.

50 miles, 10-16-inch, gas, offshore Louisiana, FPC authorization.

Texas Eastern Transmission Corp., Shreveport, La.

66 miles, 30-inch, gas, loops, between Vidor, Texas, and Lambertville, N. J., and 33,710 hp in four existing stations, $17.5 million, temporary FPC authorization.

165 miles, 20-inch, gas, West Monroe, La., to Kosciusko, Miss.; 128 miles, 30-inch, loops, between Kosciusko and Lambertville, N. J., and 37 miles, laterals in New Jersey, 51,000 hp., $55.2 million, before FPC.

144 miles, gas, 46,300 hp. $27.8 million, for 1962, before FPC.

Texas Gas Transmission Corp., Owensboro, Ky., 96 miles, 26-30-inch, gas loops, Louisiana, Arkansas, Mississippi, Tennessee, Kentucky and Indiana; 50 miles, 8 and 16-inch extension into Terrebonne, La., producing area, $16.8 million, before FPC.

Transcontinental Gas Pipe Line Corporation, Houston.

211 miles, 36-inch, and 69 miles, 30-inch, loops and additional 32,040 hp, in Texas, Louisiana, Mississippi, Alabama, Georgia and South Carolina, $52 million, FPC examiner approval.

163 miles, 36-inch, gas, loops, in Louisiana, Alabama, Mississippi, Georgia, North and South Carolina, Virginia, Maryland and Pennsylvania, 10,500 hp, $30 million, before FPC.

13 miles, 24-inch and 18 miles, 20-inch loops, Louisiana, FPC authorization. 14 miles, 16-inch laterals, 1-mile, 12-inch lateral, Louisiana, $2.1 million, FPC authorization.

29 miles, 20-inch, gas, and 2,500 hp, in South Texas to take gas from South Texas Natural Gas Gathering Co., $2.4 million, FPC authorization.

Trans-Southern Pipeline Corp., Houston, 1,080 miles, 12-inch, LPG, from Mont Belvieu, Texas, to Danville, Va., and 215-mile spur line from Atlanta to Georgia-Florida border, $63 million, planned.

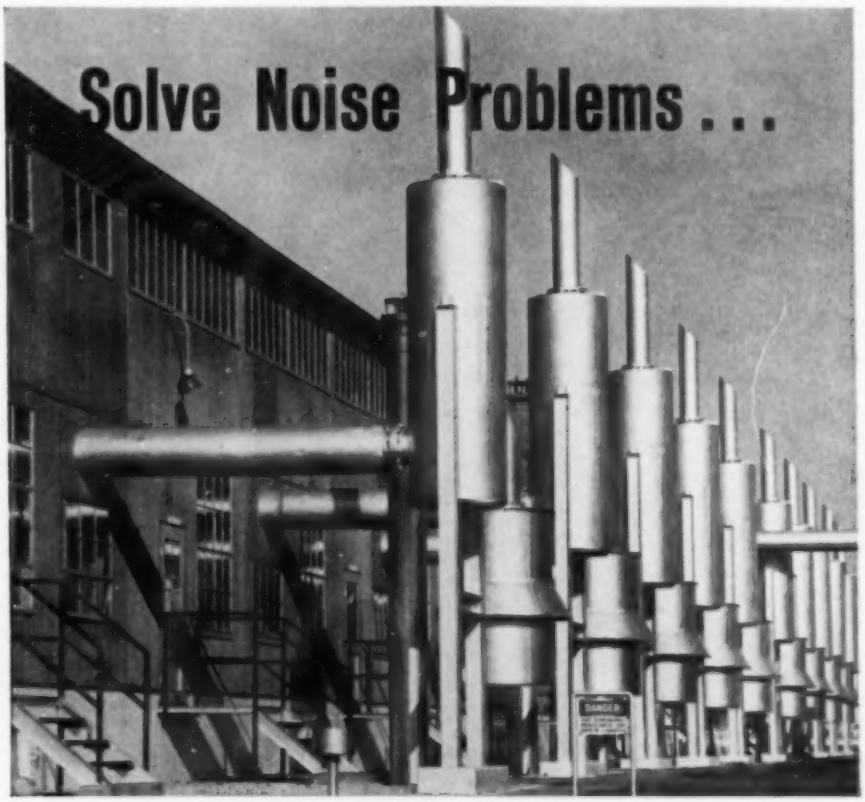
Trunkline Gas Company, Houston, 252 miles, 30-inch loops, and 140 miles, laterals, between Longville, La., and Tuscola, Ill., $45 million. Contracts let on 155 miles to Cape Construction, Western Pipe Line, Panama-Williams, Panama Inc., and Grayco.

United Gas Pipe Line Co., Shreveport, La., 59 miles, 36-inch, gas, lateral between Bastian Bay field and Plaquemines Parish, La., before FPC.

217 miles, 30-inch, gas, Lafayette to Monroe, La., planned.

Valley Gas Transmission, Inc., Houston, 55 miles, 3 to 8-inch, gas, gathering,

Continued on Page 100



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There's no need to go-it-alone when your design problem deals with noise suppression. You can save time and money by putting a MAXIM engineer on your team.

He is a specialist in designing silencers to meet noise problems of all types of engines from giant diesels to "go-karts," as well as special purpose silencers for jet aircraft, atomic submarines, waste disposal plants, chemical plants and heat recovery applications.

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New time multiplexing and remote se
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Five new basic time multiplexing systems—and a new remote index setting feature—add to the overall versatility of *Dur-O-Pulse* . . . give you advantages available in no other telemetering system.

With Time Multiplexing Units—

- You can transmit up to 15 signals either in one or two directions over a single channel.
- You can add intermediate stations without adding any additional transmission lines.

With Remote Set Index—

- Easy to set—set the index, push a button and the rest is automatic: a pulse whose duration is directly proportional to the value of the set point is transmitted to remotely located controllers.
- Can be used as part of a multiplexing system.

The *Dur-O-Pulse* system measures and transmits process variables such as pressure, temperature, flow, level, voltage, current, power and speed. It can send data quickly and accurately over all types of circuits.

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set index setting simplify operation

Dur-O-Pulse telemetering systems

- Gives you set point indication at transmitting and receiving instruments.
- A single tone is required for the index signal when audio tone multiplexing is used.

Find out about *all* the performance and maintenance advantages of *Dur-O-Pulse* from your nearby Honeywell field engineer. Call him today . . . he's as near as your phone.

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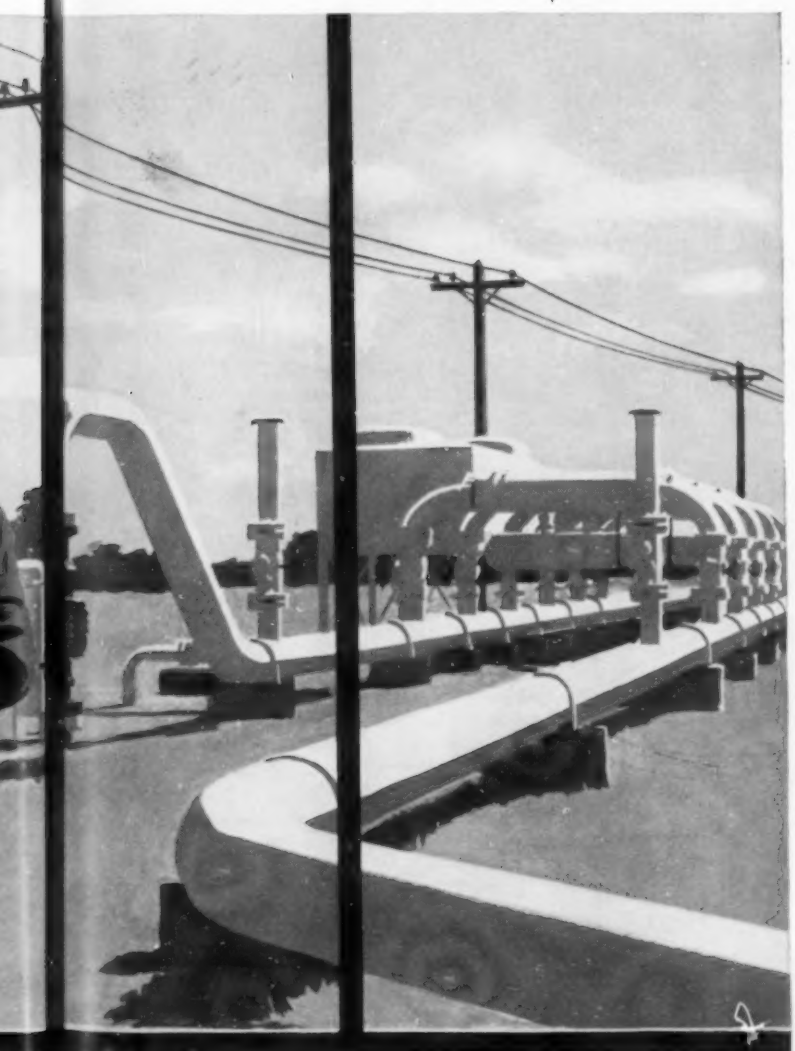
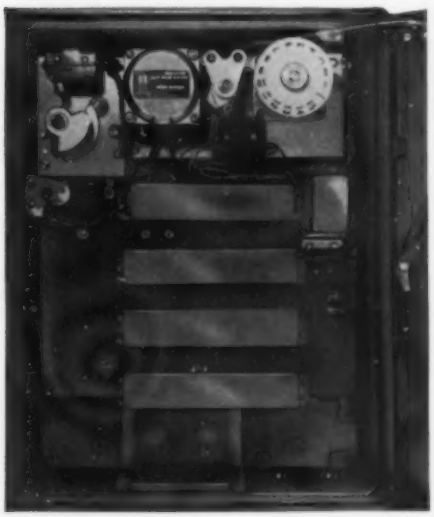


REMOTE-SET INDEX TRANSMITTER eliminates separate push buttons or switches needed to drive controller index up or down scale. To readjust controller index it is necessary only to adjust the indicating pointer to the desired set point and push the start button.



TIME MULTIPLEXING UNITS transmit up to 15 variables in one or both directions and provide a synchronizing signal to keep transmitting and receiving units in step.

Honeywell

First in Control

SINCE 1885

PROPOSED CONSTRUCTION

continued

in Hidalgo, Brooks, Starr and Jim Wells counties, Texas, $15 million, before FPC.

West Shore Pipe Line Co., 285 miles, 10-16-inch, products, East Chicago, Ind., to Green Bay, Wis., $22 million, planned.

International

ACT Oils, Ltd., Montreal, 400 miles, crude, Dawson Creek, B. C., to Bella Coola, B. C., before B. C. Government.

Ajax Alberta Pipeline Ltd., 28 miles, 10-inch, gas, main, Morinville to Westlock, Alta., planned.

Assistencia de Oleodutos du Petrobras, Rio de Janeiro, 280 miles, 12-inch, crude, Rio de Janeiro to Belo Horizonte, Brazil, planned.

Abu Dhabi Marine Areas Ltd., (British Petroleum Co. and Compagnie Francaise Des Petroles) 20 miles, 18-inch, crude, from Umm Shaif offshore oilfield to Das Island, Persian Gulf, planned.

Barnabos Group (Italian Interests), crude line from Venice, Italy, to Insbruck, Austria, with extension to Munich, Germany, planned.

TOGETHER FOR GOOD

Reilly Coal Tar Enamels and related primers, used together, provide the corrosion protection needed by underground metal structures. The Reilly hot enamel system is:

electrically insulated	oxidationproof
waterproof	stressproof
oilproof	tough and strong
bacteriaproof	permanently bonded

In addition, Reilly coating systems offer ultimate longevity because they inherit the chemical inertness and stability of coal tar, from which they are made.

Specify Reilly hot-applied coal tar enamels and related primers for oil, gas and water pipelines.

REILLY ENAMEL AND PRIMER

Reilly Pipeline Enamel	Reilly Pipeline Primer	Reilly Redhead® Primer
Reilly Intermediate Enamel	Reilly QD Primer	
Reilly 230-A Enamel	Reilly 230 X-10 Primer	
Reilly 230 AWWA Enamel	Reilly 230 X-10 Primer	
Reilly Hot Service Enamel	Reilly 230 X-10 Primer	

REILLY TAR & CHEMICAL CORP.
1615 MERCHANTS BANK BUILDING, INDIANAPOLIS 4, INDIANA

Reilly COAL TAR PRODUCTS
ARMEX Protective Coatings

Bituminous Oil Pipeline Co., Calgary, 250 miles, crude, from Athabasca tar sand plant in northeastern Alberta to Edmonton, approved.

British American Oil Co., Ltd., Toronto, 125 miles, gas, Pincher Creek fields to Calgary, Alta., before Alberta Public Utilities Board.

Burmah Oil Co., Ltd., 850 miles, crude, 20 inch, from Nahorkatiya to Calcutta, India. Contract let on 250 miles to **Mannesmann-Saipem.**

Cartier Gas Corp. (St. Maurice Gas, Inc., and Consumers Gas Co., Toronto), 170 miles, gas, Montreal to Quebec City, planned.

Consolidated Gathering Systems, Ltd., Calgary, 198 miles, crude, Sturgeon field to Edmonton, planned.

Foothills Pipe Lines Ltd., 1,300 miles, LPG, from Alberta-Saskatchewan border to Chicago, tie-in with Westalta Products Pipeline proposed system in Alberta, $100 million, before Alberta Board of Public Utilities Commissioners.

Gas del Estado, Buenos Aires, 1,050 miles, 30-inch, gas, Comodoro Rivadavia field to Buenos Aires, $380 million, bids submitted for design and construction by Texas Eastern Transmission Corp., ENI, and an Argentine firm.

Gas Trunk Line of British Columbia, Vancouver, 250 miles, 30-inch, gas, main, Fort Nelson to Taylor, B. C., planned.

Gases Naturales de Colombia, S.A., 140-mile, 10-inch, gas, Cicuco field to Barranquilla, Colombia, underway.

Gasversorgung Sueddeutschland, 180 miles, gas, Mannheim to Karlsruhe to Kehl and Ulm, $20 million, planned.

Hughenden Pipeline, 125 miles, products, Dick Lake gasoline plant to Hughenden Region, Alta., planned.

Hydrocarbons Pipeline, Ltd., Winnipeg, Manitoba, 880 miles, 6-8 inch, products, from Edmonton to Winnipeg, $35 million, partial authorization.

Independent Pipe Line Co., 2,019 miles, 34-36-inch, crude, Edmonton to Montreal, 23,000 pump horsepower, $395 million, before Borden Commission.

Interprovincial Pipe Line Company, 350-mile extension from Toronto to Montreal, looping line from Edmonton to Toronto, crude, $240 million, considered, products pipe line, Superior, Wis., to Chicago, considered.

Mid-Continent Pipe Lines, Ltd., 1500-mile, 30-inch crude, Edmonton to Chicago, planned.

Naphtha Israel Oil Co., 75 miles, 6-inch, gas, Rosh-Zohar field to Ashdod Yam on Mediterranean planned.

National Iranian Oil Co., 146 miles, 6 inch, crude, from Azna to Isfahan, Iran, $5 million, planned.

Northern Alberta Pipe Lines, Ltd., Edmonton, Alta., 110 miles, 10-inch, gas, main, Lac La Biche to Edmonton, $3 million, planned.

Northern Pipe Line Company, 153 miles, 16-inch, crude, from Regina, Saskatchewan, to Clearbrook, Minn., $10 million, planned.

Continued on Page 102

Acme-Newport Steel

CONSTANT LABORATORY CONTROL . . .

PROVIDES QUALITY IN ELECTRIC WELD LINE PIPE

Metallurgists call every play in the production of steel at Acme-Newport. They provide the diet for gulping furnaces, check samples at every step. In addition to chemical and physical checks of the steel itself, line pipe undergoes flattening tests, visual and hydrostatic inspections . . . and a final examination by Acme-Newport's new electronic device that scans for defects invisible to the human eye.

Nothing less satisfies this Company and its customers. Let Acme-Newport serve you, too, with electric weld line pipe in 4″ and 6″ sizes, standard or thin wall.

Acme-Newport Steel COMPANY
NEWPORT, KENTUCKY
A SUBSIDIARY OF ACME STEEL COMPANY

SIZES AND WEIGHTS AVAILABLE

O.D.	Wall	Wt. Per Ft.
4½	.125″	5.84
	.142″	6.61
	.156″	7.25
	.188″	8.64
	.219″	10.00
	.237″	10.79
6⅝	.156″	10.78
	.188″	12.89
	.219″	14.97
	.250″	17.02
	.280″	18.97

PROPOSED CONSTRUCTION

continued

Oasis Oil Co., of Libya, (Amerada, Continental and Ohio Oil Company), 86 miles, 30-inch, Dahra field to Es Sider, Libya; 36 miles, 20-inch, Mabruk to point between Es Sider-Dahra, before Libyan Petroleum Commission.

Peace River Oil Pipe Line Co., Ltd., 70-mile, crude, Swan Hills to Iosegun Junction, approved.

Petroleos Mexicanos, 4, 6 and 8-inch, products, Mexico City-Puebla to Cuernavaca, planned.

1,240 miles, 34-inch, gas, Reynosa to Mexicali, Mexico, $160 million, negotiating with Tennessee Gas Pipeline Company for design and construction of the line.

360 mile, 12-inch, products, Minatitlan to Puebla and Mexico City, planned.

Products, Guadalajara to Tepic, planned.

Products, Aguascalientes to Zacatecas, planned.

6-inch, products, Guaymas to Ciudad Obregon, considered.

8-inch products, Guaymas to Hermosillo, considered.

8-inch, gas, Tierra Blanca to Veracruz.

Gas, Ciudad Carmen to Ciudad Pemex.

8-inch, crude Comalcalco to Minatitlan.

Crude, Minatitlan to Salina Cruz, contingent on proposed refinery on Pacific Coast.

149 miles, 10-inch, products, Ciudad Pemex to Minatitlan, planned.

181 miles, 4-inch, products, Mexico City to Salamanca, planned.

280 miles, crude, Tampico to Brownsville, Texas, $16 million, considered.

Pipelines of Puerto Rico, Inc., 95 miles, 8-inch, products, Penuelas to San Juan, Puerto Rico, approved.

Provincial Pipe Lines, Ltd., 700 miles, 3-16-inch, hydrocarbon line gathering system in Alberta, $25 million, before Alberta Oil and Gas Conservation Board.

Qatar Petroleum Company, Qatar, 60 miles, 6-10-inch, gas, Dukhan to Doha, Qatar, engineering contract let to Pencol Pipeline & Engineering Consultants.

Quebec Gas Transmission Lines, Inc., Montreal, 300 miles, gas, main, Quebec to Montreal, planned.

Rangeland Pipe Line Company Limited, 111 miles, 8-inch, crude, southeastern Alberta to Calgary, $3 million, planned.

Saskatchewan Power Corp., 179 miles, 4-6-8-inch, gas, planned.

Societa Nazionale Metanodotti, 650 miles, 18-inch, crude, Genoa, to Milan-Cremona-Torino, Italy, and Aigle, Switzerland, with extensions to Karlsruhe and Munich, Germany, planned.

Societe du Pipe Line Sud-European, Paris, 432 miles, 34-inch, crude, port of Lavera to Strasbourg, with lateral extending 40 miles to Karlsruhe, Germany, approved by French cabinet.

Soc. Siciliana Metanadotti, gas line from Hassi R'Mel field in Algeria through Tunisia, across Mediterranean to Sicily and into Italy, considered.

Standard-Vacuum Oil Company, 60 miles, 8-inch, gas, main, in South Sumatra, considered.

Ste. d-Etudes de Pipeline Intercontinetaux, Paris, 1,400 miles, 30-40-inch, gas, from Hassi R'Mel field in central Algeria across Mediterranean, through Spain, France and into West Germany, considered, Fish International Corporation making engineering and feasibility studies.

Sui Gas Transmission Co., Multan, Punjab, India, 145 miles, 8-inch, gas, from Sylhet to Dacca, East Pakistan, $9 million, considered.

130 miles, 16-inch, gas, main line, Multan to Lyallpur, planned.

Syrian Pipeline, Damascus, 500 miles, crude, from Karshuk field, Syria, to Mediterranean, planned.

300 miles, products, from Homs to tank farms in Damascus, Aleppo and Latakia, planned.

Trans-Prairie Pipelines, Ltd., Edmonton, crude line, from Weyburn field to Regina-Moose Jaw areas, $5 million, considered.

Trunk Pipelines Ltd., London, 70 miles, products, Canvey Island to Denham, Buckinghamshire, bill before Parliament. Extension of line from Denham to Birmingham, planned.

Continued on Page 104

the
SPREAD
is the thing . . .

. . . that makes the difference. The **spread** between a first class job and a mediocre one is simply this . . . the **spread** between close attention to details and a slip-shod operation.

Sheehan Spreads are famous for their close attention to details as well as friendly relations with property owners. From the first estimate to final clean-up, Sheehan's careful planning and efficient operation is aimed at making sure your job is a job well done.

Sheehan SPREADS . . . the mark of quality in pipeline construction

SHEEHAN PIPE LINE CONSTRUCTION CO. TULSA OKLA.

SHEEHAN

NATIONAL BANK OF TULSA BUILDING
TULSA, OKLAHOMA

For more data on advertised products, use Readers' Service Cards, last page.

Proved Protection Against Pipe Corrosion Makes PLICOFLEX TAPE the Specified Choice On Major Pipe Line Projects

All Over the Free World

Major pipe line projects in Libya (100 miles of 30″ pipe), United States (80 miles of 30″ pipe), Chile, Tierra Del Fuego oil field (all crude and products lines in field), France (83 miles of 8″ pipe), Colombia (140 miles of 10″ pipe), and the Persian Gulf (6″, 8″ and 12″ pipe), that have used Plicoflex pipe line tape recently (Oct. 1960—Mar. 1961) are only some of the many examples of pipe lines where Plicoflex was the *specified* corrosion resistant material.

Plicoflex laminated butyl-vinyl tape used in combination with Plicoflex butyl base primer is moisture proof · non-conductive · impact resistant · bacteria proof · abrasion resistant · soil stress resistant · chemical resistant.

Application is simple . . . all you need do is give the pipe a good wire brushing, apply the primer at prevailing temperature and wrap and ditch the pipe.

10 colors, 4 thicknesses available.
Write for descriptive literature or demonstration.

PLICOFLEX

PLICOFLEX, INC.
2425 Mowery Rd. P. O. Box 45911
Houston 45, Texas JAckson 6-3711

PROPOSED CONSTRUCTION

continued

Westalta Products Pipeline Ltd., 900 miles, LPG, from Northern Alberta to Saskatchewan border, to deliver hydrocarbons to Foothills Pipe Lines, $40 million, before Alberta Board of Public Utilities Commissioners.

Williams-McWilliams Industries, Inc., New York, 441 miles, 6-inch, crude, Villa Montes, Bolivia, to Villa Hayes, Paraguay, considered.

Westcoast Transmission Company, 500 miles, 12-inch, crude, Taylor to Kamloops, B. C., $30 million, British Columbia government approval.

ON THE LINE

NEUC Emerges

An educational and promotional association has been formed to disseminate facts regarding power and fuel costs. The National Engine Use Council (NEUC) is more specifically dedicated to increase sales of engines, fuels, lubricants and accessory equipment in competition with electric power.

The council plans a program of education at all levels from high school, through university to the ultimate consumer. It plans also to step up promotion through technical literature, brochures and advertising.

The NEUC association is introduced in an 8-page brochure which includes its aims and a list of the advisory committee.

Information can be obtained from the National Engine Use Council, P.O. Box 22177, Los Angeles 22.

Stocks Climb

American Gas Association reports that natural gas common stocks have continued to climb for the fourth consecutive month reaching a new peak of $58.42 per share in March.

This is a 24.3 percent increase over last year. Dividends continued at a record level of $2.31 per share, 9 percent higher than a year ago.

Distribution stocks jumped to a new high of $55.21 and dividends rose to a record of $1.91 a share. Stock price is 37 percent over last year. Transmission stocks ended the month at $65.41 a share, up 15.2 percent over a year ago. Dividend remained at $2.81 a share which is 10.6 percent higher than last year and equal to a yield of 4.3 percent.

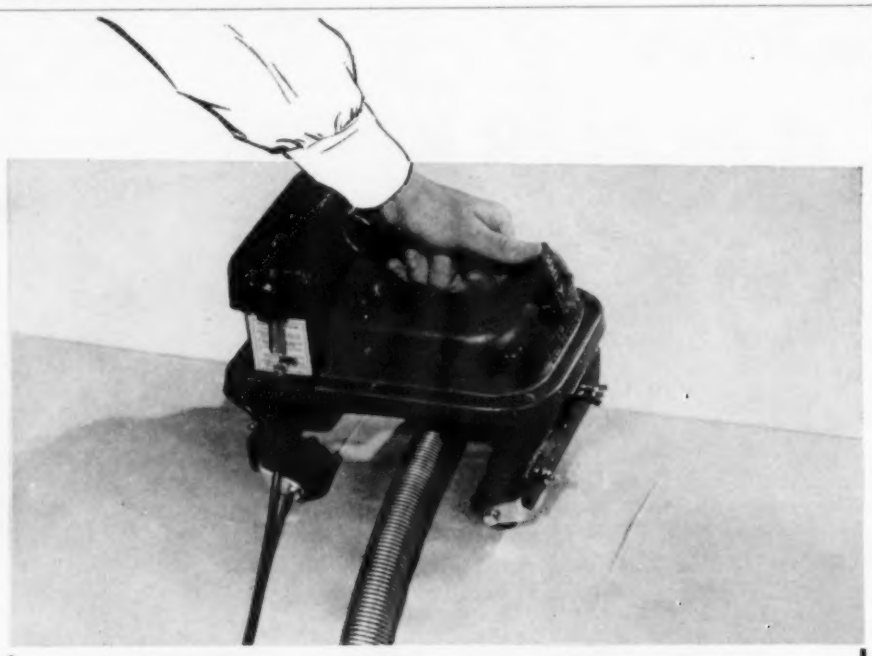
Pipelines Passed Up

Dr. Eliezer Krumbein, assistant director of education at the Transportation Center Northwestern University, claims that pipe line companies and other transportation industries are on the short end of attracting college graduates.

Most bright graduates loom toward manufacturing concerns and pass up the transportation field, Krumbein said. With the purpose of reversing that trend, a 5-week course on executive development programs will be offered at Northwestern University. The Sixth annual Executive Program will be conducted June 19 through July 21. The course is designed primarily for junior and middle-management executives, not college students.

Krumbein feels that more aggressive executive development programs within transportation companies will help overcome the graduate's fear of "winding up in a dead end situation."

The executive course is designed to provide specialized programs to broaden outlook of executives in the industry. For further information,



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ELIMINATE HOLIDAYS and their consequences with accurate, reliable SPY Holiday Detectors. Compact and light in weight for one-man operation. Carrying or rolling models available. Detectors set to your job specifications:

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- **all pipe sizes**
- **all types coatings**

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Spy Detector QUALITY SERVICE

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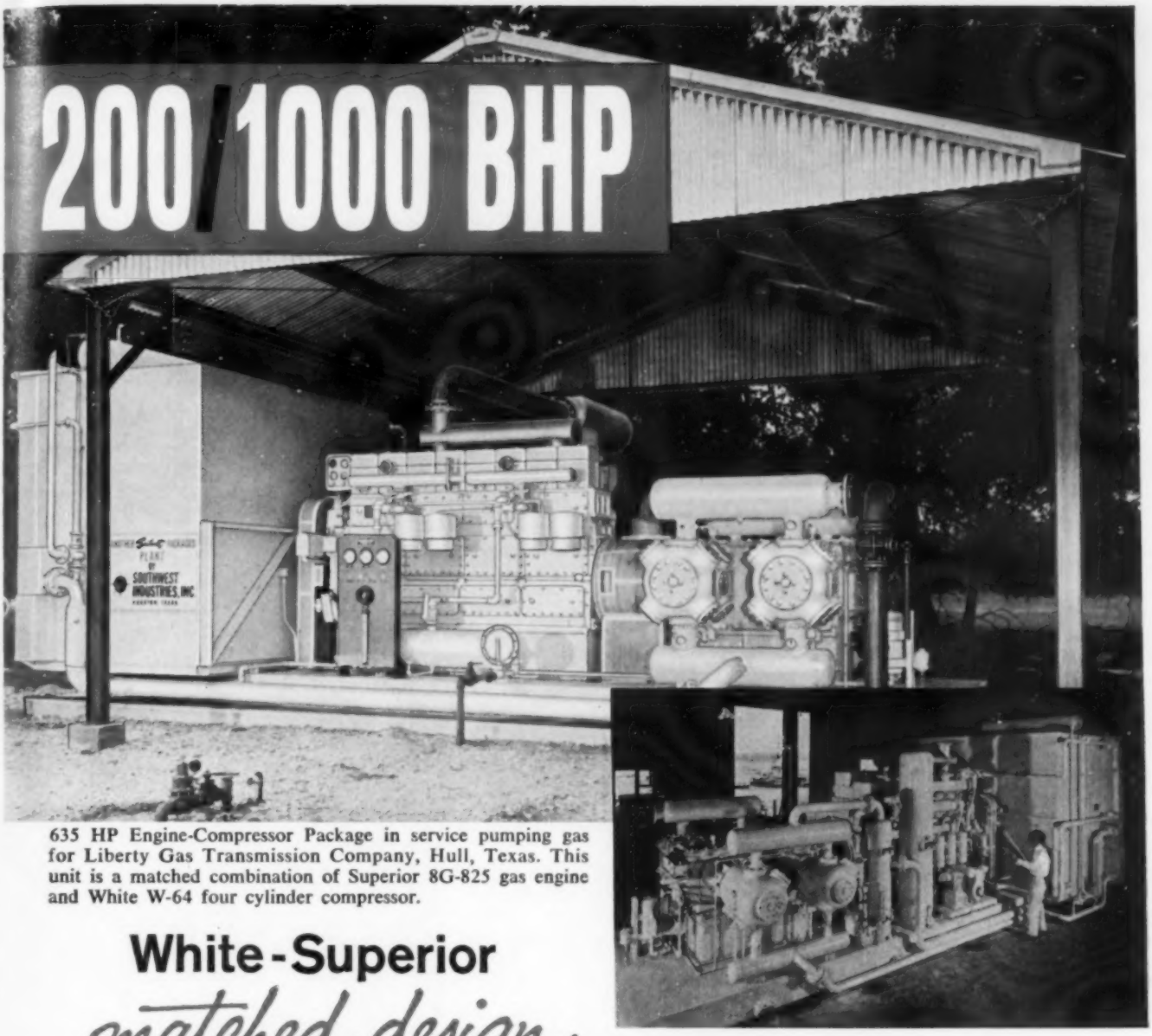


635 HP Engine-Compressor Package in service pumping gas for Liberty Gas Transmission Company, Hull, Texas. This unit is a matched combination of Superior 8G-825 gas engine and White W-64 four cylinder compressor.

White-Superior *matched design* ENGINE-COMPRESSORS

White Diesel announces a line of medium speed, heavy duty, balanced opposed compressors, 200 to 1000 BHP, specifically engineered for combination with Superior natural gas engines. The complete, compact, *matched design* engine-compressor package provides continuous, heavy duty service for gas gathering, gas lifting, repressuring and booster applications.

Six inch stroke White compressors coupled to 9 inch and 10½ inch stroke Superior oil field gas engines provide optimum combinations of piston speed, horsepower and service life. Model W-62, two-cylinder compressor, ranges from 200 BHP with Superior 6G-510 gas engine to 635 BHP with 8G-825. Model W-64, four-cylinder compressor, is rated up to 1000 BHP with supercharged 8GX-825 gas engine. Standard cylinder sizes range from 4000 PSI, 2⅝" dia. to 85 PSI, 22½" dia., providing 68 different cylinders. Custom sizes and designs available.

Speed of direct-connected engines (no belts or gears) can be varied from 600 to 900 RPM for easy control of compressor unit. Compressor cylinders can be easily changed on same frame to suit changing volume or pressure conditions.

Get new Bulletin 124 from White oil field representatives . . . or write today to:

Superior ENGINES | White DIESEL

White Diesel
WHITE DIESEL ENGINE DIVISION
THE WHITE MOTOR COMPANY
Plant and General Offices: Springfield, Ohio

Are your costs too HIGH?

These pipeliners are cutting costs – using SIE control systems

DISPATCHERS CONSOLE used by Cherokee Pipe Line Company for automatic control of liquid line.

SIEMARC Supervisory Systems provide automatic monitoring and remote control for many industrial operations and processes including the petroleum installation pictured. Measuring, data gathering, telemetering, logging, display, indicating and computing are all integrated in the system. Both solid-state and relay components are used as dictated by proper engineering design. Transistors and semiconductor diodes are utilized in all high-speed switching and logic circuits including encoders, decoders, analog-to-digital converters, deviation detectors and magnetic drum circuitry. Separate electric logging typewriters record data and alarms.

POWER LEVEL CONTROLLER used by Shell Pipe Line Corp. Ozark System for maximum pumping station operating economy.

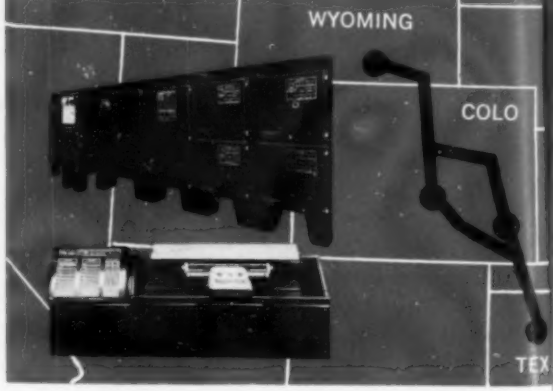
Completely unattended operation of a multi-unit pumping station is possible with Power Level Controllers used by Shell Pipe Line Corp. The unit accepts signals from flow and pressure pickups and makes logic decisions to bring proper combinations of pump units on or off stream automatically. It may be connected to the supervisory control system to permit reset of power levels from a central office dispatching console.

COMPRESSOR STATION CONTROL CONSOLE including complete engine control equipment for automatic station operation and safety.

For gas transmission automation, the basic SIEMARC system can be coupled with Log-Alarm Shutdown and Engine Control-Sequence units. Building block design throughout allows SIE to fit your needs exactly.

DISPATCH PANEL used by Colorado Interstate Gas Company.

In the Colorado Interstate Gas Company installation shown, dispatchers transmit only desired discharge pressure settings; automation at each compressor station responds by maintaining the selected value for optimum station economy. If communication links fail, local automation operates without interruption. Log-Alarm units insure station safety. Dispatchers are alerted only when trouble occurs.



Pioneers in solid state systems for supervisory control and telemetering.

DAY | NIGHT | SERVICE
Call: SUnset 2-2083
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DRESSER ELECTRONICS

SIE DIVISION ONE OF THE DRESSER INDUSTRIES

10201 Westheimer, Houston 42, Texas

The first volume in a series on how SIE handles supervisory control and automation for the petroleum industry is now available. The booklet gives the ABC's of land line codes, binary techniques — and many more of the basics. A letter brings you "The ABC's of Industrial Telemetering."

contact Dr. Krumbein, Transportation Center at Northwestern University, 1818 Hinman Avenue, Evanston, Ill.

Continental Plans Building

Continental Oil Company plans a three story building in Ponca City, Okla., to house the new central Computer Department and company's process center.

The building will contain 32,000 square feet of machine and office space. The $775,000 project is scheduled for completion in early 1962. It will house 200 employes, including 60 engineers in the process center. The Computer department was established in 1960.

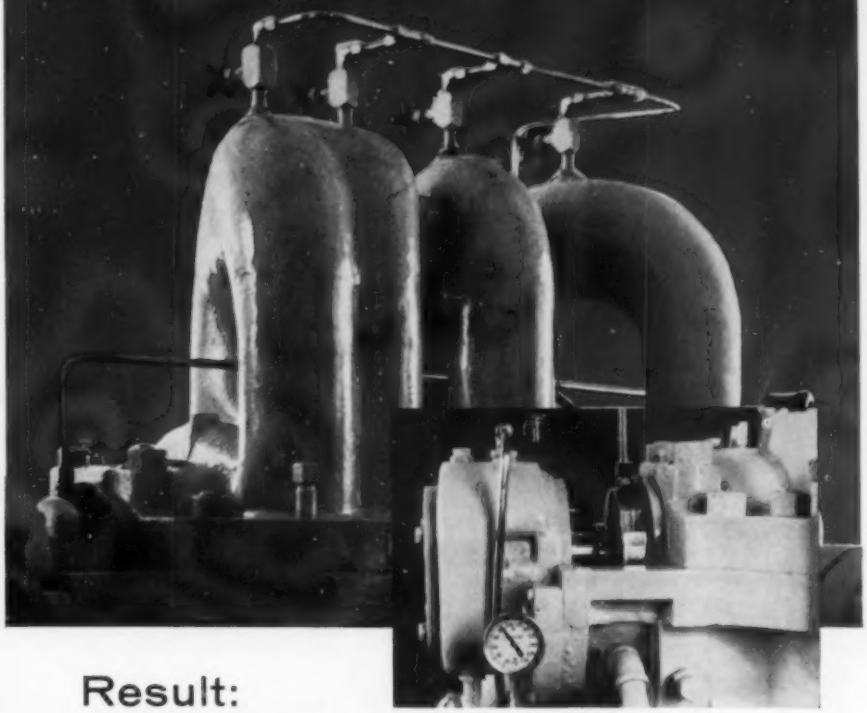
Receiving the Award for Caterpillar is J. L. Geddes, left. Dr. D. Wells, foundation president, right, presents award while director Lyle W. Sheppard looks on. At lower right is detail of award and lower left shows typical ad in the series.

Caterpillar Awarded

For its National Goals advertising program, Caterpillar Tractor Company was awarded the 1960 George Washington Honor Medal by the Freedom Foundation at Valley Forge.

The program was designed to stir public awareness of the country's growth needs in various fields. The program includes 12 different topics with different areas covered in successive advertisements. Topics are highways, housing, urban renewal and rehabilitation, education, water resources, hospital facilities, soil conservation practices, electrical power, mining, petroleum, logging and dams.

*Atlantic Pipeline standardizes on Borg-Warner Mechanical Seals with exclusive "Pre-setting Ring"**



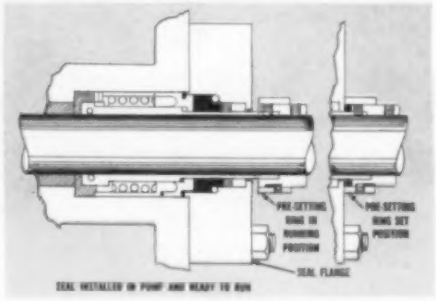
Result:

Up to 50% less maintenance

Since their first installation over four years ago, Atlantic Pipeline Company's Eastern Division has standardized on Borg-Warner Mechanical Seals on main line, booster and calibrating pumps. To date, experience with 26 pumps shows up to 50% less frequent maintenance; a marked decrease in product losses through leakage and evaporation; reduction of hazardous fumes; plus the economy of standard, interchangeable seals. Seals at Atlantic Pipeline's Product System operate under all conditions from inches of vacuum to 1300 psi, with *no pump down time due to seal failure!*

Here's how it works:

Complete Seal unit slips onto shaft—bolts to the stuffingbox. Pre-setting ring is then locked in running position to assure perfect spring tension.



*Pat. Pending

Borg-Warner Mechanical Seals

A PRODUCT OF B-W BORG-WARNER

DIVISION OF BORG-WARNER CORPORATION

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IS BETTER BUILT TO GIVE YOU

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You get more trench for your money—day in and day out—and at less cost with an AUBURN. Simple and rugged in design, it's virtually trouble-free. Its variable hydraulic drive automatically adjusts the speed to changing soil conditions. One man operates it digging up to 800' per hour, 6" to 14" wide and down to 6' deep.

Job proven . . . AUBURN is the first choice of contractors, utility and telephone companies throughout the world. It is the most profitable trencher you'll ever own, ask any AUBURN owner . . . he'll recommend it.

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PIPELINE VENTS AND MARKERS

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Pipe Line Division

COMPLETE PIPE LINE ENGINEERING SERVICE

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DRAFTSMEN

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What's Happening

among MEN in the INDUSTRY

E. B. Dunn, Atlantic Pipe Line Company, was named president of the Petroleum Industry Electrical Association at its annual meeting in Galveston, April 11-13. Clifton D. Campbell, Houston Texas Gas & Oil Corporation, was elected vice president and Fred S. Jones, Platte Pipe Line Company, was named secretary-treasurer. Joseph E. Keller, second from left, general counsel for PIEA, is pictured with the directors. Left to right are Ivan M. Cook, Shell Oil Company; Keller; Campbell; C. E. Upson, chairman of the board, Natural Gas Pipeline Company; J. O. Mostrom, Phillips Petroleum Company; Dunn; J. S. Schull, Texas Pipe Line Company; Jones, and Frank J. Geisel, Atlantic Pipe Line Company, who is general chairman for the 1962 convention scheduled for Dallas, April 10-12.

Ernest B. Blease has been named vice president of **Northern Natural Gas Company.** He will head the newly established regulatory and forecasting division at Northern. Blease, who has been with the company since 1951, will direct preparations of applications to the FPC for system expansion and rate revisions, supervise preparation of the firm's budget and direct forecasting activities. Before joining Northern he had been with the FPC for 14 years.

Ernest B. Blease

Humble Oil & Refining Company has formed a new natural gas division with **W. J. Greenwald** general manager. Three coordinators have been named to assist Greenwald and **John J. Carter,** manager of the division.

W. D. Moore has been named economics and planning coordinator responsible for industrial market development, economic evaluation of gas sales proposals and advance planning on matters affecting gas utilization. He had been senior supervising engineer in charge of long-range planning in the Production Department. **W. E. Curry, Jr.,** formerly contract supervisor in Humble's Gas Department, is the new negotiating and marketing coordinator. **J. R. Suman, Jr.,** has been named supply and Federal Power Commissioner coordinator with responsibility for maintaining records on gas reserves, maintaining necessary statistics on sales, budgets and net income, as well as coordinating filings with the FPC for interstate gas sales. He was coordinator of gas supply in the Gas Department of Humble Division.

Remick McDowell, chairman of **Peoples Gas Light and Coke Company,** has been elected chairman of the boards of several Peoples Gas subsidiaries. He replaces **Eskil I. Bjork** who remains as a director.

The subsidiaries include **Natural Gas Pipeline Company of America, Natural Gas Storage Company of Illinois, Peoples Production Company, Texoma Production Company, Kimswick Development Company** and **Union Hill Gas Storage Company. Leslie A. Brandt,** president of Peoples Gas, was named a director of NGPL, Texoma and Peoples Production Companies. **Wayne Simpson** has been made a vice president of NGPL, Natural Gas Storage and Texoma. He is controller of the other subsidiaries. **H. S. Cain, N. L. McClure** and **A. L. Seidel** were elected assistant controllers of NGPL, Natural Gas Storage and Texoma.

John W. Emison, chairman of the board of the **Texas Pipe Line Company,** has retired after more than 40 years service with the company. He became chairman February this year when **H. S. McCray** succeeded him as president. He joined Texas Pipe Line in 1920 as a clerk in the Houston office. He became chief accountant in 1929, and in 1939, treasurer. He was

Special Report to Users of Caterpillar Equipment: Custom TRACK SERVICE

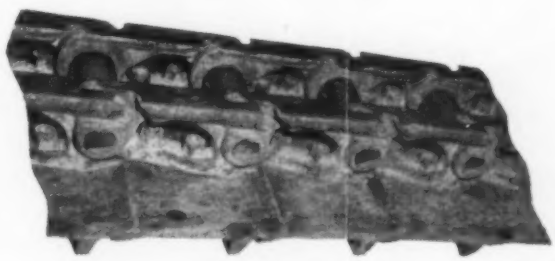
Custom Track Service saves coal stripper $3298 by adding 3800 hours to track life

A coal stripper, ripping and 'dozing rocky overburden 7 days a week around the clock, was averaging 2300 hours of life before he *replaced* most of his totally destroyed track group parts. At the suggestion of his Cat Dealer, the stripper tried new, larger-size undercarriage parts. By following recommendations of the dealer's undercarriage specialist at 2440 and 4030 hours, the undercarriage went a total of 6100 hours with only pin and bushing replacements . . . and all but the shoes were rebuildable instead of scrap! Up to this point, Custom Track Service saved the stripper a $3298 cash outlay; and since he was able to rebuild the links and reuse the pins and bushings instead of replacing with new assemblies, he realized additional savings.

PAST EXPERIENCE

ALL BUT SHOES READY FOR SCRAP PILE AFTER 2300 HOURS

PRESENT EXPERIENCE



COMPLETELY REBUILDABLE EXCEPT SHOES AFTER 6100 HOURS

HOW CUSTOM TRACK SERVICE HELPS LOWER COSTS

Custom Track Service, available only from your Caterpillar Dealer, is designed to help you get the most possible service from undercarriage parts and thus cut costs. Factory-trained specialists are ready to help solve your particular track problems. They can give sound recommendations to help you get the most from your undercarriage.

They can advise you on maintenance . . . help you tailor the many special undercarriage parts and track options available to meet various job conditions. As a result, costs per hour go down and profit and machine availability go up.

These undercarriage specialists are backed by modern track undercarriage rebuilding facilities manned by experienced personnel . . . by the largest and most complete stock of standard and special application parts available . . . by Parts Exchange Assemblies that keep tractors working and earning.

Check with your Cat Dealer and learn how Custom Track Service can help you to reduce costs.

Caterpillar Tractor Co., General Offices, Peoria, Ill., U.S.A.

CATERPILLAR

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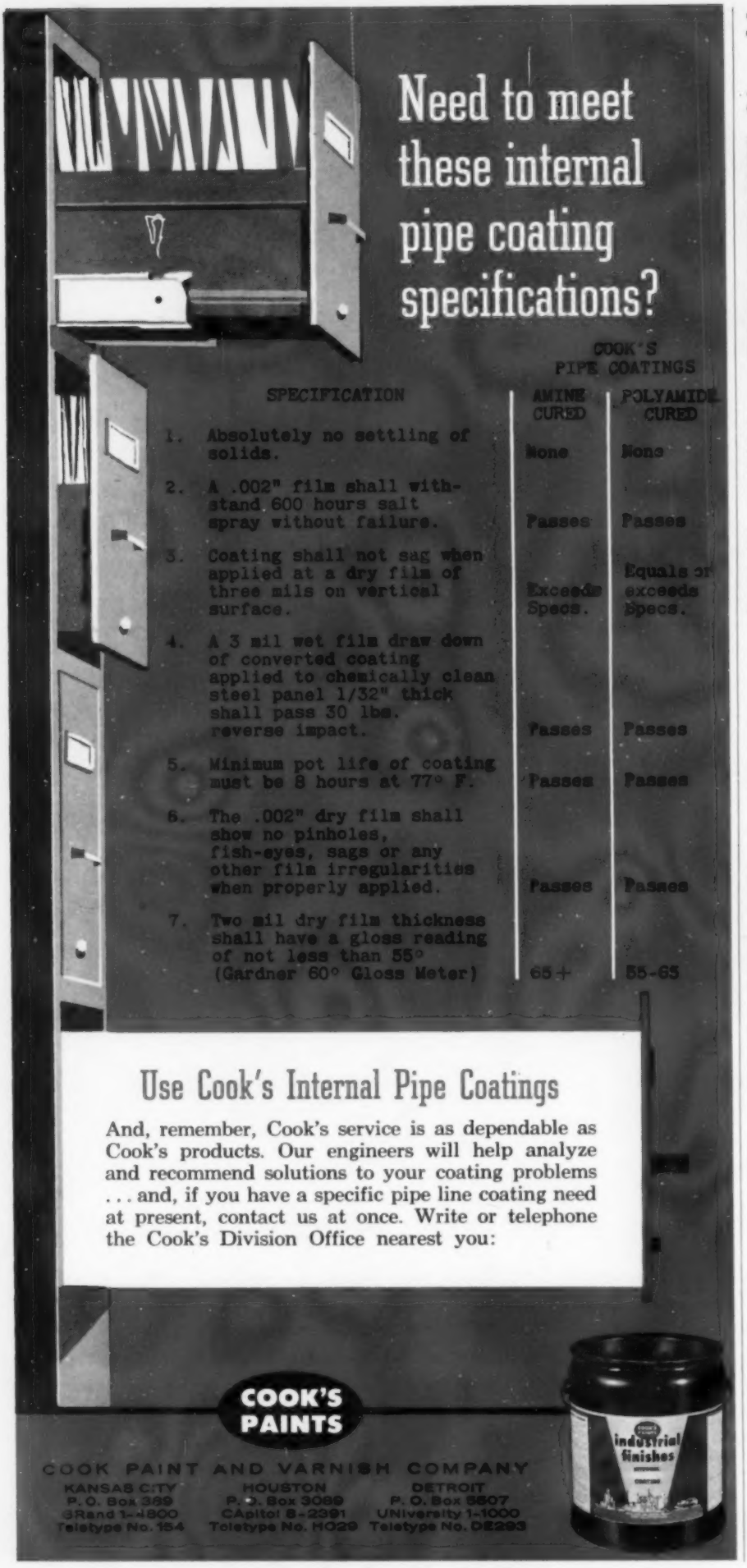
Need to meet these internal pipe coating specifications?
COOK'S PIPE COATINGS
SPECIFICATION
AMINE CURED
POLYAMIDE CURED
1. Absolutely no settling of solids. None None
2. A .002" film shall withstand 600 hours salt spray without failure. Passes Passes
3. Coating shall not sag when applied at a dry film of three mils on vertical surface. Exceeds Specs. Equals or exceeds Specs.
4. A 3 mil wet film draw down of converted coating applied to chemically clean steel panel 1/32" thick shall pass 30 lbs. reverse impact. Passes Passes
5. Minimum pot life of coating must be 8 hours at 77° F. Passes Passes
6. The .002" dry film shall show no pinholes, fish-eyes, sags or any other film irregularities when properly applied. Passes Passes
7. Two mil dry film thickness shall have a gloss reading of not less than 55° (Gardner 60° Gloss Meter) 65+ 55-65
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And, remember, Cook's service is as dependable as Cook's products. Our engineers will help analyze and recommend solutions to your coating problems . . . and, if you have a specific pipe line coating need at present, contact us at once. Write or telephone the Cook's Division Office nearest you:
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DETROIT P. O. Box 5607 UNiversity 1-1000 Teletype No. DE293

elected a vice president in 1947, and president in 1952.

Stanford O. Tostengard has been named district superintendent for **Gulf Refining Company's** New Orleans District. Since 1960 he has been foreman of the company's Leesville, La., area. He succeeds **J. A. Brown,** who has **retired after** more than 40 years with the company.

S. O. Tostengard

Tostengard has been with Gulf since 1949. In 1953, he became staff assistant to the general manager of the Pipe Line Department and was named assistant district superintendent in the Buras, La., District in 1959. Tostengard will supervise Gulf's pipe line operations in eastern Louisiana and southern Mississippi.

Nelson M. Lytle, Interstate Oil Pipe Line Company's assistant district superintendent in Sunset, La., District, has been transferred to Billings, Mont., District. He succeeds H. S. Foote, who retired as district superintendent.

Lytle has been with the company for 33 years.

John Holder, electrical and communications supervisor since 1956 for **Service Pipe Line Company,** retired after 41 years with the company. He started with Service in 1920 as a telegrapher. He is a member of the PIEA.

Frank E. Williams has been named vice president in charge of the newly established pipe line division of **Walker and Associates, Inc., Engineers. Harold L. Hartl** and **Robert H. Marlowe** have been named project engineers in the division.

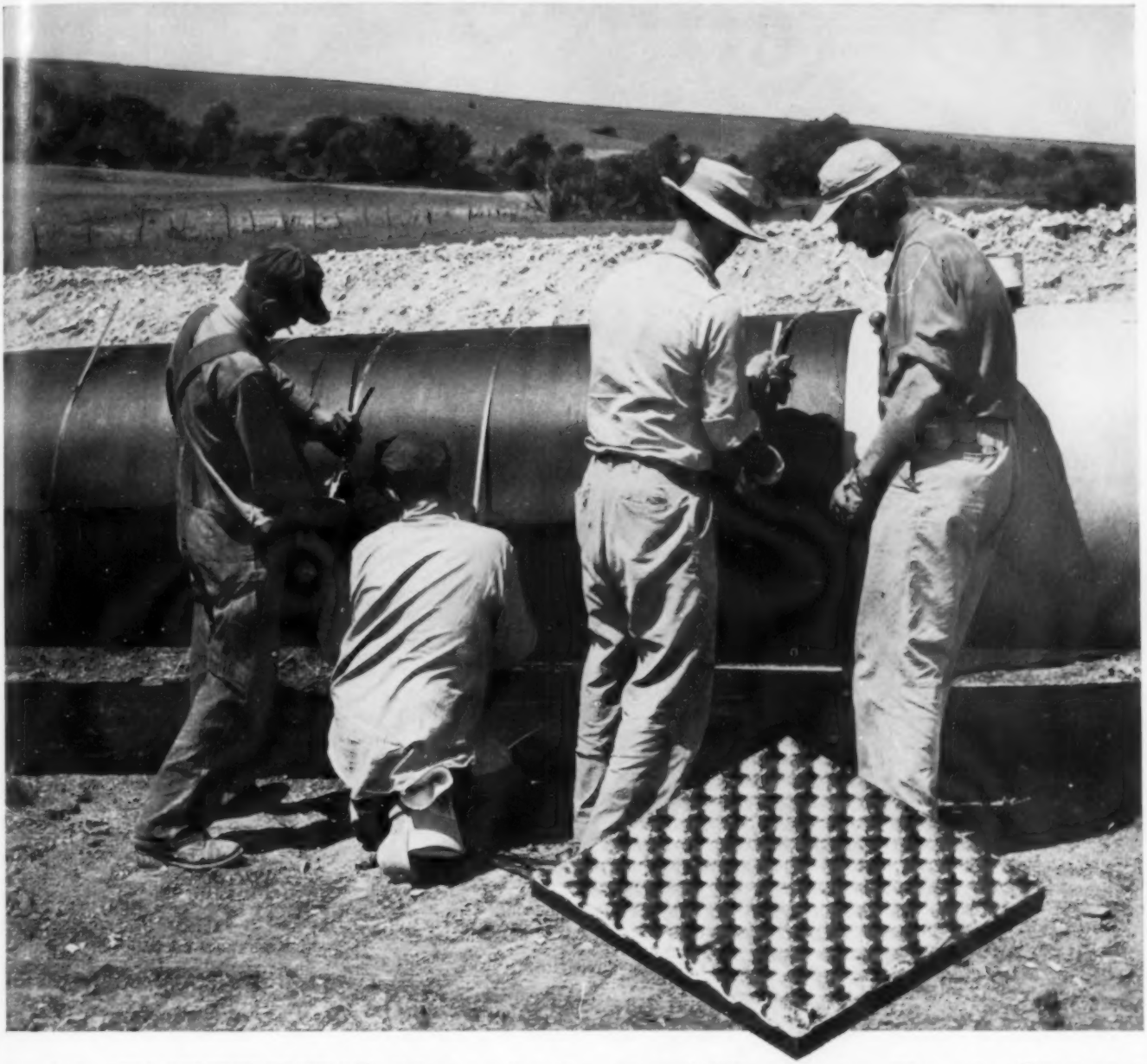
Frank E. Williams

Williams formerly was head of Transcontinental Gas Pipe Line Corporation's Drafting Department. Hartl and Morlowe, with wide experience in the pipe line field, will be in charge of major pipe line projects. The division specializes in pipe line surveying, design and drafting.

Brother B. Austin Barry F.S.C., of the civil engineering faculty of **Manhattan College** in New York City, was elected president of the American Congress on Surveying and Mapping. **Walter S. Dix,** liaison officer in Washington for **T.V.A. Maps** and **Surveys Branch,** was named vice president. Elections were announced at twenty-first annual meeting in Washington March 22-25.

Brother Barry has been at Manhattan College since 1943, and is assistant professor of civil engineering in charge of surveying. Dix is a surveyor and professional engineer registered in the District of Columbia and Ohio.

WRAP UP THE JOB



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All Youngstown electric weld line pipe 12¾" O.D. and over is hydrostatically expanded. Brute power of water pressure works the metal, expands it, strengthens it. Each length is given roundness and straightness. Result . . . better welding and bending qualities. And on all Youngstown line pipe, precision tests and quality controls assure the high standards of performance you demand.

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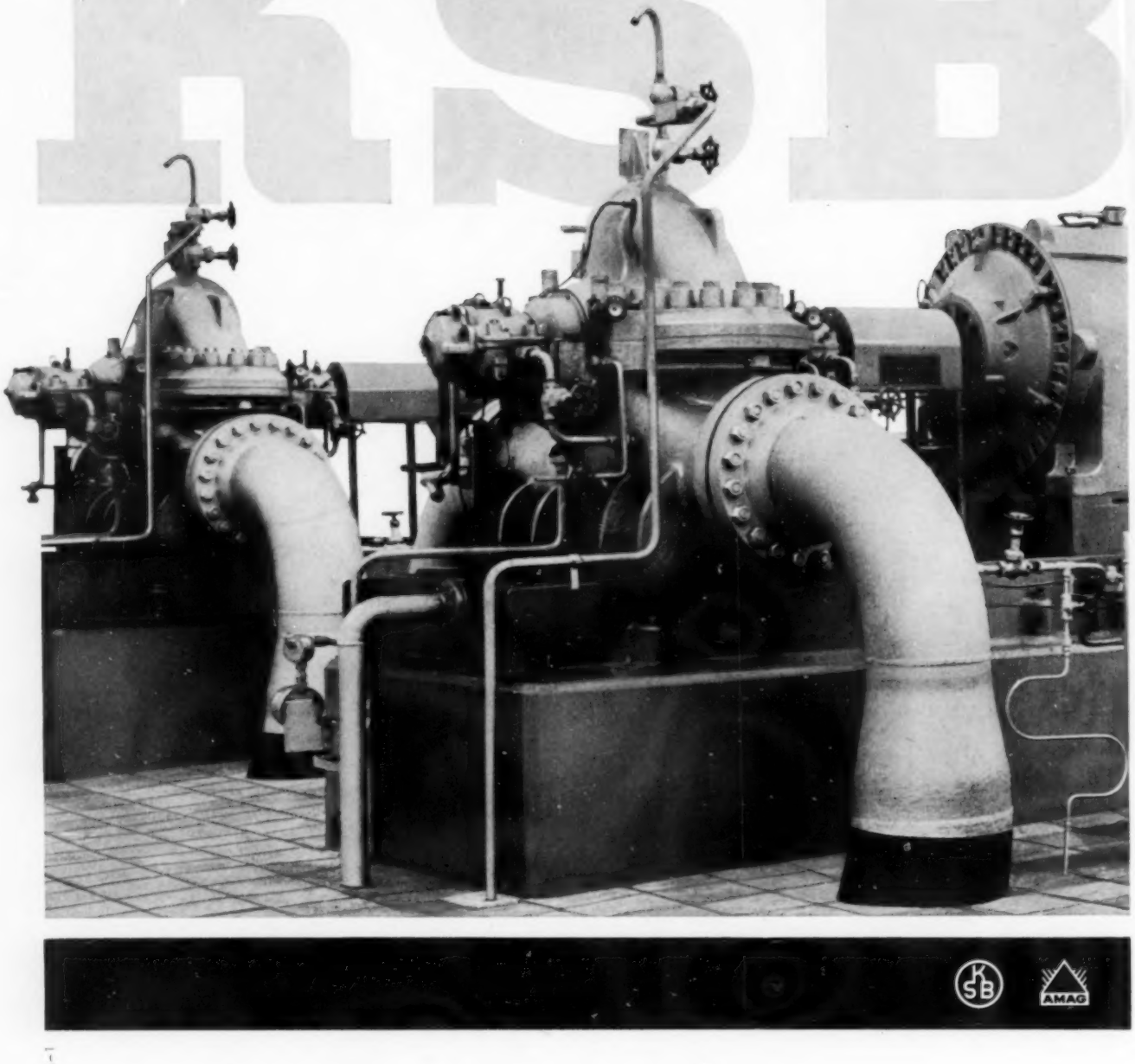

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The sturdy construction and high-class workmanship of these pumps enable them to meet the most exacting service conditions.

KSB

Klein, Schanzlin & Becker Aktiengesellschaft, Frankenthal (Pfalz) Germany

Fred S. Jones has been promoted to chief engineer of **Platte Pipe Line Company**. He has been superintendent of engineering and communications. As chief engineer he will administer and supervise all general, electrical and communications engineering functions.

Fred S. Jones

Joining the company as a microwave technician in 1952, Jones helped build the company's five-state communications and remote control system. He is a member of the IRE and associate member of the AIEE. Also he is secretary of the PIEA and a member of the central committee on communications facilities for the API.

The **Natural Gasoline Association of America** elected **Max R. Lents,** vice president and general manager of the **Reef Corporation,** president. Vice presidents elected include **G. W. McCullough,** vice president of **Phillips Petroleum Co.; K. G. Pearce,** vice president of **Tenneco Oil Co.; Albert Taylor,** executive assistant, **Amerada Petroleum Corp.** and **C. T. Wells, Jr.;** president of **Goliad Corp.**

F. Cushing Smith, executive vice president and a director of **American Oil Company,** has joined the Advisory Committee of the Transportation Center at Northwestern University. The center is a national educational and research organization serving the transportation industry. The advisory committee consists of 33 business and transportation leaders.

L. M. (Larry) Jack has been named superintendent of right of way and **Ross H. Foster** assistant superintendent of right of way for **Service Pipe Line Company.** Jack succeeds **Homer R. Swift,** who retired after 27 years of service. Foster replaces Jack.

K. R. Dailey has been named assistant manager of **Humble Oil & Refining Company** Employe Relations Department. He was employe relations manager of Humble prior to its merger with several affiliates, and has been serving as employe relations manager of the new company's Humble Division.

Under the revised organization, the company will have two assistant managers. **J. N. Gorringe** continues to serve in this capacity. Dailey has been with the company since 1927.

Deaths

S. Miller Williams Jr., Tulsa, one of the founders of Williams Brothers Company, died of a heart attack April 6 in Terre Haute, Ind. He was 73 years old.

In 1908, S. Miller and David R. Williams, Sr., formed Williams Brothers Construction Company which over the years has accounted for 40,000 miles of the nation's pipe lines. With S. Miller Williams as president, the company also became a major international construction firm.

The founding brothers retired in 1950, but S. Miller Williams continued to be active in the pipe line industry and attended the annual contractors conventions through 1961. In 1959, he was recognized at the International Petroleum Exposition where he received the "Grand Old Man of Transportation" award.

Edward S. Plank, 60, of Tennessee Gas Transmission Company, died while on a business trip in Lafayette, La., March 20. Death was attributed to a heart attack.

He had been with TGT since 1944, and was superintendent of the Gas Measurement Department of Tennessee Gas Pipeline Company, A TGT Division.

Winfred E. Reynolds, retired senior vice president and director of Ford, Bacon & Davis, Inc., died March 7 of a heart attack in Brunswick, Ga. He was 80 years old.

He retired in 1947 after 28 years service with the company.

WHO'S MEETING WHERE

May

Pacific Coast Gas Association, transmission conference, Biltmore Hotel, Santa Barbara, Calif., May 4-5.

AGA, operating section, distribution and production conference, Sheraton Hotel, Philadelphia, May 8-12.

NGAA, Permian Basin regional meeting, Lincoln Hotel, Odessa, Texas, May 12.

ISA, AIEE, ARS, IAS, IRE, National Telemetering Conference, Chicago, May 22-24.

AGA, Operating Section, transmission, annual meeting, Brown Palace, Denver, May 25-26.

June

ISA, international instrument-automation conference and exhibit, Royal York Hotel, Toronto, Can. June 5-8.

Appalachian Underground Corrosion Short Course, annual meeting, West Virginia University, Morgantown, W. Va., June 6-8.

ASME, summer annual meeting, Statler Hilton Hotel, Los Angeles, June 11-14.

Canadian Gas Association, annual meeting, Grand Hotel, Mackinac Island, Mich., June 20-24.

AIEE, ASME, IRE, ISA, AIChE, second joint automatic control conference, University of Colorado, Boulder, Colo., June 28-30.

September

Pacific Coast Gas Association, convention and annual meeting, Coronado Hotel, Coronado, Calif., September 13-15.

NGAA, Rocky Mountain Regional meeting, Northern Hotel, Billings, Mont., September 14.

AIEE, petroleum industry conference, New Orleans, September 17-20.

ASME, petroleum division conference, Kansas City, September 24-27.

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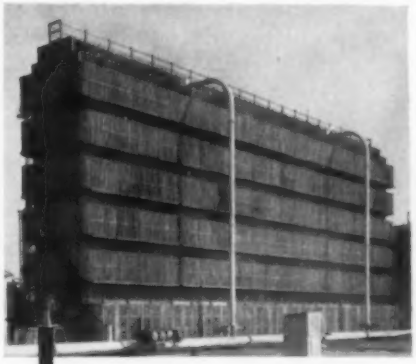

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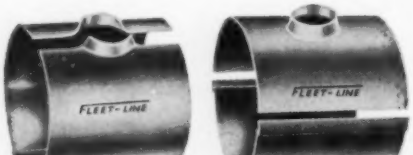
REDUCERS: Concentric and eccentric. Nominal pipe sizes 1" to 30", ASA B16.9, ASTM A234. Schedules 10 to 160, stainless steel, and other alloys. Special lengths and sizes.

SADDLES: Conventional, and for pressure vessel heads. Nozzle sizes from ¼" to 24". Fleet-Line saddles weld neatly into place in much less time, and with much less welding rod.

Full encirclement saddles.



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What's Happening among SERVICE and SUPPLY MEN

The Petroleum Electric Supply Association elected officers and directors at the annual PIEA-PESA meeting in Galveston April 11-13. From left to right, are T. T. Wagner, Kellogg ITT; E. E. Tuel, Railway Communications, Inc.; George H. Ullrich, Jr., Motorola Communications & Electronics, Inc., executive secretary and treasurer; C. A. Gunn, Copperweld Steel Company, president; John D. Trilsch, Trilsch Tower Corp., chairman of the board; Alan Urschel, Collins Radio Company; Harry Holquist, *Pipe Line News;* Felix F. House, Crouse-Hinds Company, and Pat Wilson, Southwestern Bell Telephone Company, vice president. The 1962 meeting is scheduled for Dallas, April 10-12.

Cooper-Bessemer Names Boyer Vice President-Advanced Planning

R. L. Boyer has been named vice president of advanced planning for Cooper-Bessemer Corporation. He had been vice president and a director of engineering. He will work on advance product planning that may contribute to further the company's diversification program.

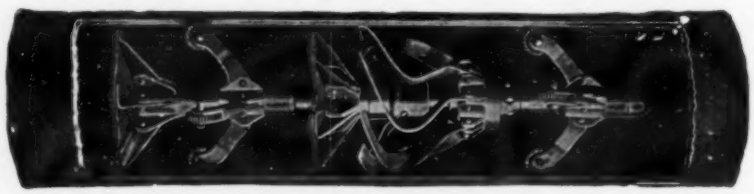
Paul R. Nagle Appointed District Manager for W-K-M

Paul R. Nagle has been named northeastern district manager for the W-K-M Division of ACF Industries, Inc. With headquarters in New York, Nagle will have sales responsibilities in his area for all lines of the Division's valves, fittings, sealing compounds and lubricants.

National Tube Division Appoints Three Managers

National Tube Division has named Paul G. Ely general manager-operations; Walter P. Rhodes becomes general manager-marketing, and William C. French, Jr., was appointed general manager-sales.

In the newly created position, Ely will be responsible for manufacturing of the firm's six plants. He formerly was assistant vice president-operations, tubing specialties. French had been sales manager, Eastern area and succeeds Louis W. Mason who is retiring. Rhodes, in a



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Go-Devil

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newly established position, will be responsible for all product divisions of National Tube as well as commercial staff functions.

Minnesota Mining Names Two New Plant Managers

R. C. Bertelsen has been moved up to St. Paul tape plant manager and A. F. Jacobson has been promoted to manager of 3M tape and adhesives, coatings and sealers plant in Bristol, Pa.

Bertelsen replaces Jacobson at St. Paul. He has been with the company since 1948. Jacobson joined the firm in 1947. He succeeds W. A. Aitken, who recently was made manufacturing manager for all 3M tape operations.

Grove Valve and Regulator Co. Elects John W. Collins President

John W. Collins has been named president of Grove Valve and Regulator Company. He has been with the company for 18 years and prior to his promotion was senior vice president and chief executive officer for the company. He has been an officer of the company since 1947.

John W. Collins

Grove also announces the appointment of Arnold H. Stephens as Southern California district manager for sales of valves and regulators. He will be headquartered in Los Angeles.

Allis-Chalmers Names Havron District Manager

William T. Havron has been named manager, industrial sales, New Orleans District for Allis-Chalmers Industries Group. He succeeds Hugh C. Blair, who was recently named manager of Phoenix District.

Union Switch & Signal Promotes Ted C. Schroeder

Ted C. Schroeder has been appointed manager-industrial projects at Union Switch & Signal—Division of Westinghouse Air Brake Company. Schroeder formerly was product manager, systems, in the General Apparatus Department.

Pipe Line Service Corp. Opens New Coating Plant

Pipe Line Service Corporation has opened its new 94,000 square foot pipe coating plant in North Lima, Ohio, near Youngstown. The plant is the eighth Pipe Line Service plant.

Bucyrus-Erie Appoints Byers Erie Works Manager

Ross C. Byers has been appointed works manager of the Erie, Pa., works of Bucyrus-Erie Co. He has been acting works manager for the past year. Byers joined the company five years ago as quality control manager of the Erie plant.

Norman B. Champ, Jr. Named Crane Vice President

Crane Co. announces the appointment of Norman B. Champ, Jr., as vice president. He will supervise operations of the Midwest Piping Division, Chapman Valve

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Manufacturing Company, Swartwout Division of Hooksett, and Cochrane Division. He had been vice president and a director of Midwest prior to Crane's acquisition of that company.

Crane also appointed Eugene H. Kolb vice president and general manager of Chapman Valve Manufacturing Company, a Crane sudsidiary. Kolb had been general manager of Ralph J. Stolle Company.

J. C. Macon, Jr., Becomes Vice President of Koppers

J. C. Macon, Jr., has been appointed vice president of Tar Products, Division of Koppers Company, Inc. He joined Koppers in 1935, and served as sales manager of Tar Products before his promotion.

T. D. Williamson Inc., Appoints Battisto Assistant Sales Manager

Steve Battisto, Jr., has been named assistant sales manager for T. D. Williamson, Inc. He joined the company in 1957 as a research and development engineer. In 1958 he became chief applications engineer.

Dresser Engineering Co. Receives Society Award

The Oklahoma Society of Professional Engineers has selected Dresser Engineering Company recipient of its outstanding award of the year.

The award is given annually to the company named as contributing most to the development of professionalism among engineers. Phillips Petroleum Co. received the honor in 1960.

Collins Radio Names Williams Vice President

Edward A. Williams has been named vice president operations control for Collins Radio Company. He formerly was controller of Collins Cedar Rapids Division. He will be representative in the areas of cost control, operations analysis, contract pricing policy and matters of a similar nature. He has been with the company for 12 years.

Pittsburgh Chemical Names Sharp Sales Representative

B. L. Sharp has been appointed sales representative for pipe line coatings and related products of Pittsburgh Chemical Company in Montana, Wyoming, North and South Dakota, Nebraska, Colorado, Kansas, Arkansas and Oklahoma. He is based in Tulsa. Formerly, he was a salesman for Standard Pipeprotections, Inc.

Harper Appointed Manager of Honeywell's Computer Department

Samuel D. Harper has been appointed manager of Minneapolis-Honeywell Regulator Company newly formed Computer Department, a part of the Special Systems division. Harper has been with the company since 1957, and had been director of sales engineering for electronic data processing division.

CompuDyne Corp. Names Clarke Vice President

John H. Clarke has been appointed vice president of Systems Division of CompuDyne Corporation. He was named manager of that Division in 1959 after serving as project engineer and the regional sales manager.

G. R. Archer has joined the company as general manager of their Process Control Division. He comes to CompuDyne

from Budd Company where he was chief engineer of the electrical control section.

RCA Microwave Department Names Milne to Product Planning

Douglas D. Milne has been named to products planning and promotion in Radio Corporation of America's Microwave Department. Milne joined RCA recently after serving 13 years with Motorola Communications and Electronics, Inc.

Rockwell Names Eldon Carlson P & I Division Product Manager

Eldon E. Carlson has been appointed western product manager for Rockwell Manufacturing Company's Petroleum and Industrial Meter Division with headquarters in Pittsburgh.

He has been with Rockwell since 1952 when he was named a sales engineer in the Corpus Christi, Texas, office. For the past four years he has been a sales engineer in Houston.

General Electric Names R. S. Wick Service Manager

R. S. Wick has been appointed product service manager for General Electric Company's two-way radio equipment and other communication's lines. Previously he was military product service organization. William Tobick has been appointed regional manager for mobile communications. He formerly was district manager at Syracuse, N. Y.

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8⅝" OD x .188", .219"
10¾" OD x .365"
12¾" OD x .219"
14" OD x .375"
24" OD x .312"
30" OD x .312", .375", .406"
36" OD x .406"

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Harry S. Jeske Named Kwik-Mix Division President

Harry S. Jeske has been named president and general manager of Koehring Company's Kwik-Mix Division. Formerly manager of Koehring's southern plant at Chattanooga, Tenn., Jeske succeeds E. W. Maas, who died March 17.

Jeske has been with Koehring for 20 years and was works manager at Kwik-Mix from 1949 to 1952.

Vermeer Manufacturing Names Carl E. Boat Sales Manager

Vermeer Manufacturing Company has appointed Carl E. Boat sales manager. He has been associated with the Sales Department since 1950. He will succeed Bill Willinger, who resigned to form a new firm, Willinger Bros. Equipment Co., in West Salem, Wisc.

Thor Power Tool Selects Slater Executive Assistant

Milton E. Slater has been named executive assistant to the president of Thor Power Tool Company. He will join the executive management staff of the parent company in the general corporate administration of all Thor divisions and subsidiaries. Slater has been in the Thor Sales Department since 1948, when he joned the company.

Chicago Pneumatic Names Oklahoma District Manager

Thomas Tefertiller has been appointed district manager of Oklahoma for oil tool division of Chicago Pneumatic Tool Company.

He has been with the company since 1955, and became assistant Oklahoma district manager in 1960.

Worthington Corp. Appoints William A. Finn Vice President

William A. Finn has been named vice president-group executive of Worthington Corporation. Formerly general manager of the company's Harrison, N. J. Division, he has been with the company since 1926. A. Edwin Carter, now vice president-manufacturing, will succeed Finn at Harrison.

Koehring Company Appoints Texas, Louisiana Distributors

Brown-Fogle Equipment Co., has been appointed distributor for southeastern Texas by Koehring, C. S. Johnson, Parsons, and Buffalo-Springfield divisions of Koehring Company. Southern Equipment & Tractor Co., Inc. has been named distributor in Louisiana for Koehring, C. S. Johnson and Parsons divisions. The affiliated distributors will handle complete line of these divisions of Koehring.

Stupp Bros. Purchases Cal-Metal Pipe Corp.

Stupp Bros. Bridge & Iron Company has purchased stock interest of Cal-Metal Pipe Corporation of Louisiana. Cal-Metal will operate as a wholly-owned subsidiary of Stupp Bros. which acquired the remaining stock interests formerly held by Cal-Metal Corporation, Torrence, Calif.

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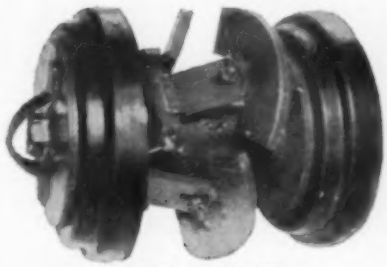
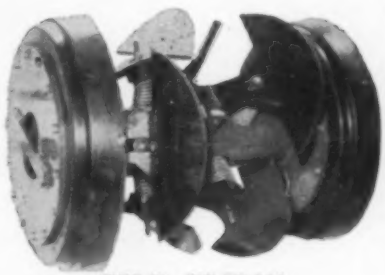


TYPE HI—6" TO 18"



TYPE HI—20" TO 36"

TYPE HI—6" to 36"

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CONSTRUCTION

These springs extend through the center of the unit to blades on the opposite side of the unit which gives it a maximum of flexibility. The heavy springs on this unit help to keep it centered in the pipe supporting its own weight which will give far greater cup life.

DESIGN

This unit is ideal for first run on new construction, or for extremely corroded pipelines.

PIPELINE CLEANERS CO.
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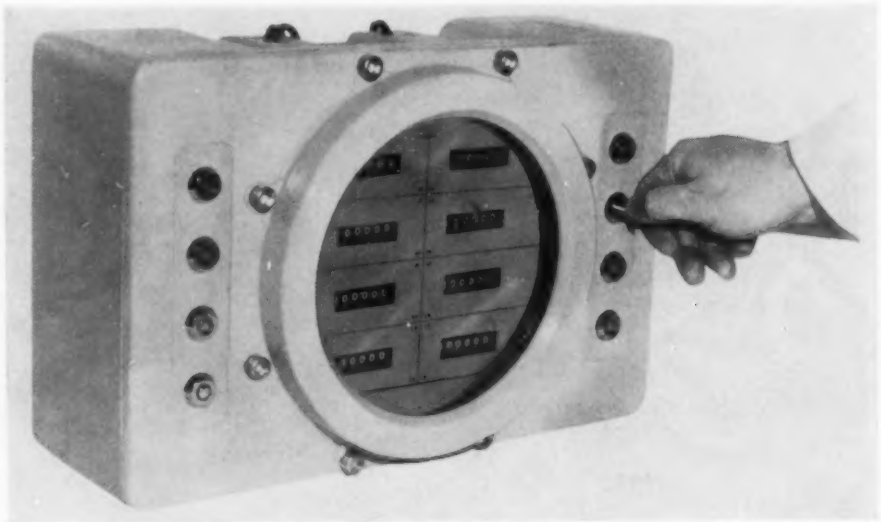
What's New in EQUIPMENT



Bulk Measurement Control

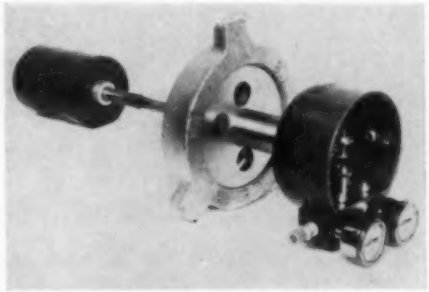
An electrically operated measurement control system for loading fluids at bulk storage terminals has been developed by Rockwell Manufacturing Company. The key control includes optional use of a solenoid-activated line block valve. The system is explosion-proof and the completely automated operation permits the use at any unattended installation; tamper-proof locking mechanisms assure registered loading.

Initial use of the system will be at a products terminal, but the system is designed for use anywhere bulk products are loaded from terminal storage into carrier vehicles. With the turn of a key, the entire electrical control system is instantly activated. Even the smallest volume of fluid removed will register on a cumulative totalizing counter.

Key control panel contains eight digit counters and key locks. Arranged in columns, four on each side, all eight can be wired for one meter. Or, one column can register removals through one meter and the other column register through a second meter; both meters can measure same or different products. The system can be used with predetermined batch control.

(This item supplements Rockwell Manufacturing Company data on pages 381-412 of the Pipe Line Catalog, Third Revision.)

For more data, circle **No. E1** on Readers' Service Card, last page this issue.



Float Control

A high pressure float control, Model CTU-415s, has been developed by Instruments, Inc. The unit features a positive displacement type float, throttling pneumatic output, hammer union connection, sight glass for visual indication and can be used for pressures up to 1,500 psi.

The float used is made of solid nitro-rubber compound discs. Float cages are available for any of the models, permitting installation external to the vessel.

(This item supplements Instruments, Inc. data on page 237 of the Pipe Line Catalog, Third Revision.)

For more data, circle **No. E2** on Readers' Service Card, last page this issue.

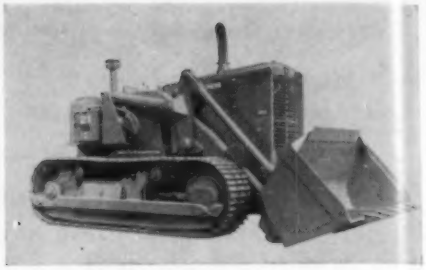
Gasket Compound

A gasket compound for leakproofing gasketed assemblies has been announced by Crane Packing Company. It can be used to repair broken gaskets, building up damaged, misaligned or warped flanged surfaces, or as a gasket substitute where surfaces permit. It is available in a soft-set and hard-set variety. Soft-set remains plastic to permit quick, easy dismantling; hard type dries quickly and sets hard. It withstands vibrations and contraction and expansion due to temperature change.

For more data, circle **No. E3** on Readers' Service Card, last page this issue.

Power Train Development

Three new power train components have been added to the Allis-Chalmers HD-21 crawler tractor. Developments are hydraulically powered oil type steering clutches; oil type steering brakes (hydraulically powered) and a spray lubricated transmission. Primary advantage of the clutch and brake is much longer operating life of the units. Hydraulic system for clutches, brakes and pressure lubricated transmission includes a two-section double-pump located on the engine. A triple filter guards the hydraulic system. A common oil sump of 40 gallons is provided by the lower part of the bevel-gear housing, steering housings and transmission case.

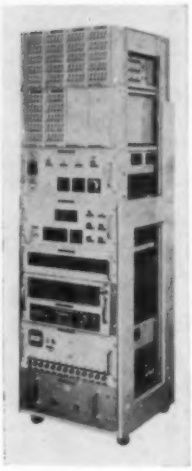


(This item supplements Allis-Chalmers Manufacturing Company data on pages 37-40 of the Pipe Line Catalog, Third Revision.)

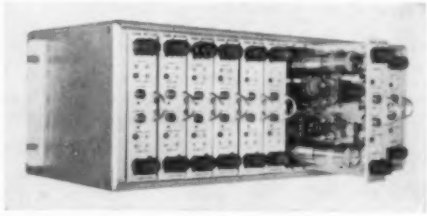
For more data, circle **No. E4** on Readers' Service Card, last page this issue.

Strain Gage Data Logger

A 200 channel instrument, Model 179 strain gage logger, contained in one standard 10-inch relay rack, has been announced by Gilmore Industries, Inc. The unit scans 200 channels of strain data at a rate of 5 channels per second. In addition to printing this data out on paper tape, it also has a high speed tape punch system which provides a coded punched tape record of all data. This can be fed to a tape reader and/or computer for further analyses and plotting of stress-strain graphs. It also has an alarm system, indicating when given input exceeds a preset strain value for any channel.



For more data, circle **No. E5** on Readers' Service Card, last page this issue.

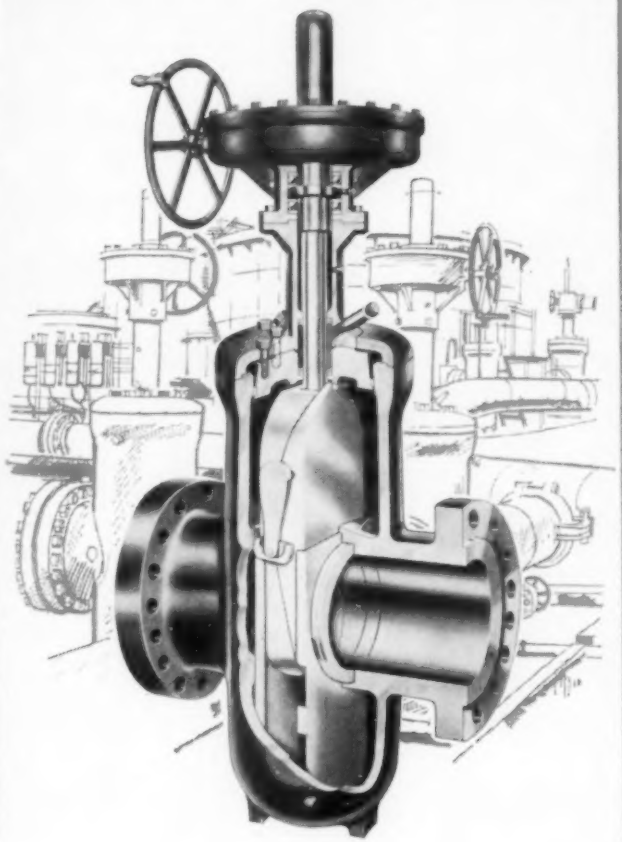


Microwave Carrier

A transistorized microwave carrier system, designated MX-106, provides maximum reliability and efficiency for multi-channel communications. Introduced by Texas Division of Collins Radio Company, the system handles 600-voice channels. An initial low channel density system can be expanded easily and economically.

The system uses frequency division principle with single sideband, suppressed carrier techniques. Frequency allocations, sideband allotment, and carrier levels are compatible with Collins MX-103, Western Electric L-Type Carrier, CCITT and others. For maximum channel density,

TWO SUPERIOR GATE VALVES FOR EVERY PIPELINE NEED



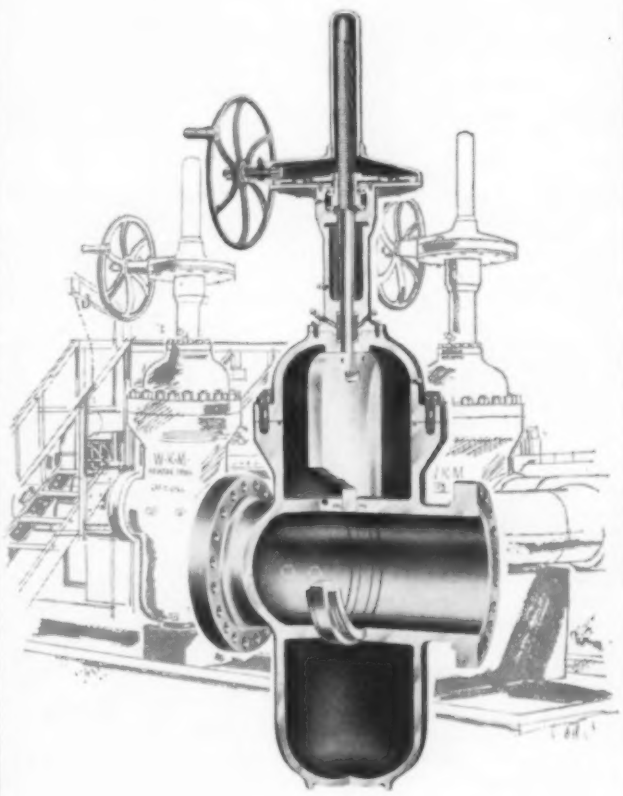
W-K-M Leverlock Through-Conduit Gate Valve

No valve made equals the W-K-M Leverlock Gate Valve where a rigid mechanical seal is demanded. Double-wedge parallel-expanding gates controlled by a mechanical centralizing device, plus steel seats with Teflon* inserts, give the most positive seal obtainable — upstream and down — under all operating conditions. Severe pressure fluctuations, from any cause, have no effect on the dead-tight seal. The W-K-M Leverlock is non-lubricated, rarely requires maintenance. On-the-line maintenance is performed in less time than removing the valve from the line. W-K-M Leverlock Gate Valves tie together most of the world's newest pipelines. Available in sizes 2" - 36", working pressures ASA 300 - ASA 2500. Send for Catalog 300, P. O. Box 2117, Houston 1, Texas.

*Du Pont's tetraflourethylene resin

W-K-M Saf-T-Seal Through-Conduit Gate Valves

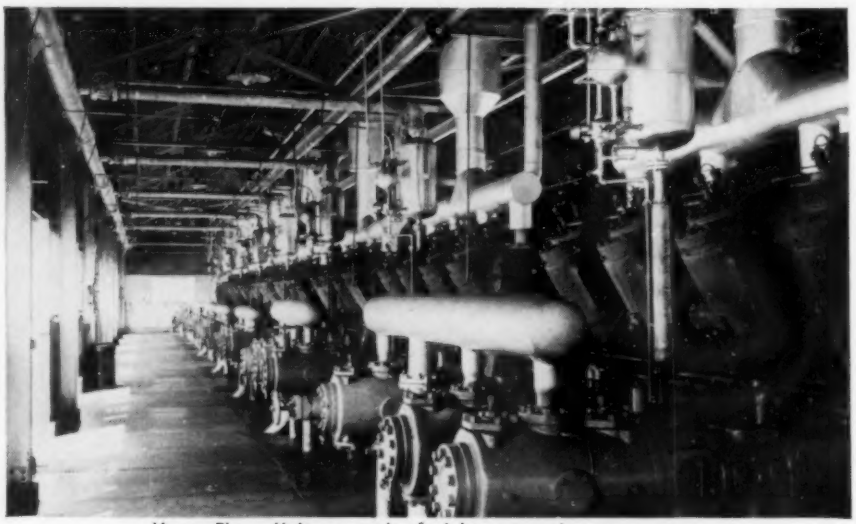
The W-K-M non-lubricated Saf-T-Seal excels in economy and efficiency wherever a pressure sealing type of gate valve is desired. It uses dynamic pressure-actuated seats with Teflon inserts. Line pressure powers the seats and gate to give a perfect up and downstream seal. The initial seal is Teflon-to-metal. Contact between the gate and the downstream seat makes a complete metal-to-metal seal. The W-K-M Saf-T-Seal Gate Valve automatically relieves excess body pressure. This valve is as maintenance-free, and easy to repair when necessary, as its companion valve, the W-K-M Leverlock. Available in sizes from 2" - 36", working pressures from ASA 150 - ASA 900. Send for Catalog WS 1061, P. O. Box 2117, Houston 1, Texas.



W-K-M DIVISION

ACF INDUSTRIES

VAPOR PHASE® PUTS ENGINE HEAT TO WORK, CUTS FUEL AND EQUIPMENT COSTS AT TIDEWATER'S VENTURA PLANT



Vapor Phase Units on each of eight gas engine compressors.

BEFORE VAPOR PHASE®

Power at the VLW Lease Gas Compressor Station consisted of eight Gas Engine Compressors of 2250 BHP total.

Engines were cooled by large radiators with fans, driven by separate multiple cylinder gas engines.

Gas-Fired Oil Heaters were used to separate water and sludge from crude oil.

Therefore Tidwater had the cost of additional engines and fuel to cool compressors, plus fuel cost to heat oil.

Crude Oil Treaters operated by 4000# steam per hour recovered by Vapor Phase from engine heat.

AFTER VAPOR PHASE® INSTALLATION

1. Engines are cooled by thermal circulation providing uniform temperature throughout the engine.
2. Separate gas engines to run radiator fans are eliminated.
3. Recovered heat from the engines produced 6750 pounds steam per hour which is fully utilized.
4. Gas-Fired boiler is eliminated.
5. 4,000 pounds of steam per hour heats the crude oil to separate water and sludge from oil.
6. Excess steam is used to heat the workmen's locker room and to drive a steam turbine for the standby condenser-engine cooler.
7. Engine maintenance is reduced.

Excess steam drives turbine for standby condenser.

E C VAPOR PHASE

ENGINEERING CONTROLS, Inc.

AN AFFILIATE OF ST. LOUIS SHIPBUILDING & STEEL CO.

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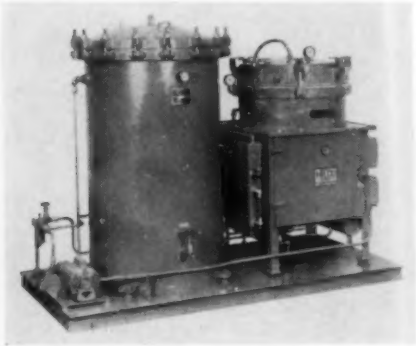
St. Louis 11, Mo.

multiple modulation techniques are used to form a composite baseband signal for transmission by broadband transmitting equipment. Components affecting signal path are semiconductors, which operate below maximum ratings. Conservatively designed, printed wiring circuits and a minimum of transistor types assure ease of maintenance.

For more data, circle **No. E6** on Readers' Service Card, last page this issue.



Filter-Reclaimer

This oil filter-combination reclaimer unit consists of a motor pump set of practically any capacity required for forcing the oil through the Hilco filter with all or parts of it diverted through to the reclaimer. The reclaimer provides final removal of moisture, water and other volatile contamination. It can be arranged where the reclaimer or filter alone can be operated for straight filtration, or in combination for removal of volatile and heavy solid contamination.

For use with the unit introduced by Hilliard Corporation, various types of filtering materials are available to handle specific types of oil.

For more data, circle **No. E7** on Readers' Service Card, last page this issue.

Crawler Tractor

Equipped with a six-cylinder, DT-691 turbocharged diesel engine, the International TD-20 (201 series) crawler has been announced by Construction Equipment Division, International Harvester Company. The company's second largest crawler, it develops 140 engine hp at 1,550 rpm. The six-speed, full-reverse transmission tractor has a drawbar hp of 113. Its shipping weight is 29,685 pounds.

A new dry-type air cleaner, 450 cfm capacity, is mounted horizontally under the hood, in an out-of-the-way position. A gasoline-conversion system, with push button feature, assures fast, all-weather

starting and a larger radiator top tank eliminates the need for an auxiliary tank on the TD-20. The new hydraulic track adjuster with built-in safety relief is standard.

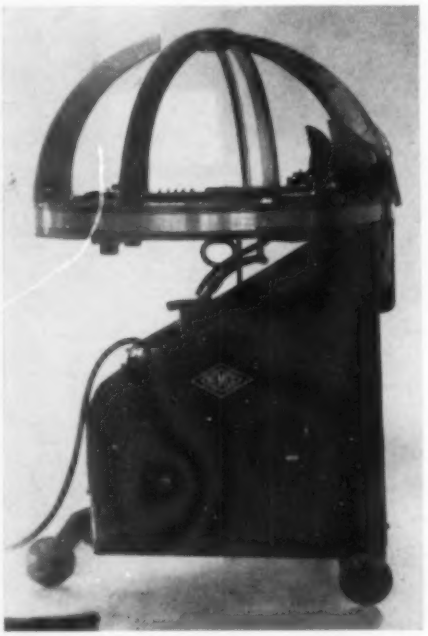
For more data, circle **No. E8** on Readers' Service Card, last page this issue.

Speed Alarm Scanner

The Bristol Company has developed a new 200-point transistorized alarm scanner capable of scanning 200 measured variables at the rate of one point per second. On discovery of any off-normal situation, the unit activates a recorder, a red alarm lamp and energizes any desired external alarm system. Upon completion of these functions, the instrument returns to normal scanning.

Under normal operation, the recorder is energized only on discovery of an alarm condition. A potentiometer with a screwdriver adjustment sets alarm condition for 20 points at a time. Lamp banks on the face of the instrument allow the operator to follow the scan point by point or manually adjust to single point scanning or recording.

For more data, circle **No. E9** on Readers' Service Card, last page this issue.



Line-up Clamp

An electro-hydraulic-powered line-up clamp operating on a new principle has been developed by Work-Remco Company. The clamp exerts up to 4,000-pounds hydraulic pressure on the entire internal circumference of both ends of the pipe to be welded. This is designed to eliminate spot pressure method of rounding ends and high-lows.

The clamp is primarily for yard welding, but easily can be converted for field operation. The hydraulic pump can be electrically operated from the welding machine or a separate generator. Push button controls operate the clamp. Available in sizes 10 thru 36-inch, it has copper back-up rings for double jointing and large ball bearing, hardened steel wheels. Plastic wheels are available for internally coated pipe.

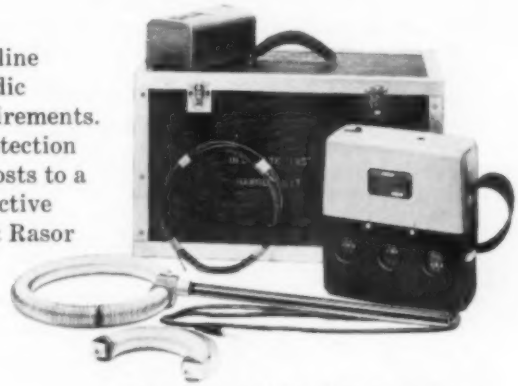
For more data, circle **No. E10** on Readers' Service Card, last page this issue.

INSPECTION IS THE KEY TO GOOD PIPE COATING

TINKER & RASOR HOLIDAY DETECTORS

insure coating continuity

Every void in your pipeline coating increases cathodic protection current requirements. To obtain maximum protection and hold maintenance costs to a minimum, inspect protective coating with a Tinker & Rasor Holiday Detector and make repairs before backfilling.



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Portable, "damp-climate" pulse type.

Write for your free Data Kit.

Tinker & Rasor has prepared a complete data kit of descriptive material and recommended procedures for inspecting protective coatings. Material includes technical data on equipment, recommended inspection procedures, general discussion of types of detectors, theory of operation, etc.

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To insure a perfect application, include Tinker & Rasor Holiday Inspection. Write for specification guide.

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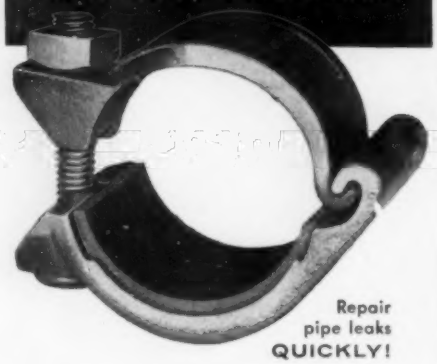
JUNIOR

EMERGENCY PIPE CLAMP



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A companion to the old reliable Emergency Pipe Clamp that has served industry for a half century, the JUNIOR, a single bolt clamp, is 2⅞" wide. Undersells most band-type clamps.

Made of malleable iron, ruggedly proportioned, with full-length hinge along one side. Formed to exact pipe size—no bending. The recessed pressure-equalizing gasket, entire width of clamp, is cemented in. A lasting installation. 2" pipe size—$1.80; 2½"—$2.20; 3"—$2.30. Write for new circular on the Junior.

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EMERGENCY PIPE CLAMPS for safe, sure lasting repair of splits and rust holes in pipe. No pressure too high. Anyone can apply in a few moments. Made in all sizes, ½" to 12", for steel and C. I. pipe. Stocked by practically all oil supply stores.

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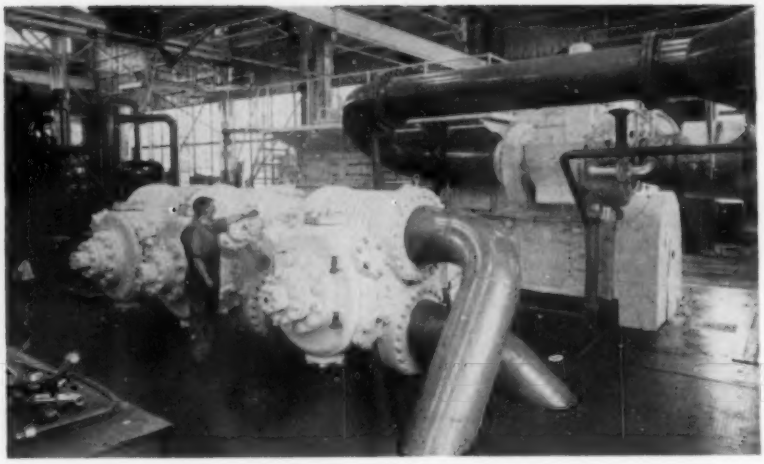


New Cylinder Design

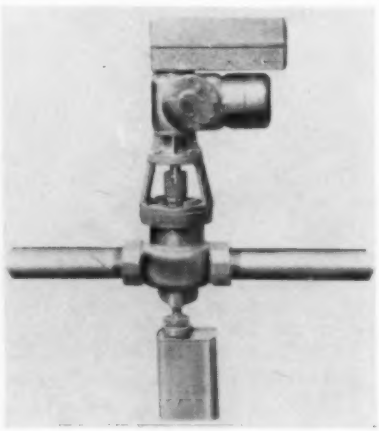
This new compressor cylinder design that eliminates separate external headers and pulsation problems features headers cast directly into the cylinder body. Suctions and discharge headers open to the sides of the cylinders and are directly connected to the lead-in, lead-out lines.

The Clark Bros. Co. "En Bloc" cylinder construction offers 1) no large external suction or discharge headers and no suction and discharge nozzles between cylinders and a conventional header; 2) built-in header eliminating pulsation problems; 3) valves opening directly into suction and discharge header areas; 4) only one inlet and one discharge pipe—both attached to foundation; and several other innovations.

The cylinder is air cooled and designed for high volume, and low compression ratio applications. The new unit is mounted on a Clark TLA-6 turbocharged gas-engine driven compressor.

(This item supplements Clark Bros. Co. data on page 72 of the Pipe Line Catalog, Third Revision.)

For more data, circle **No. E11** on Readers' Service Card, last page this issue.



Liquid Sampler

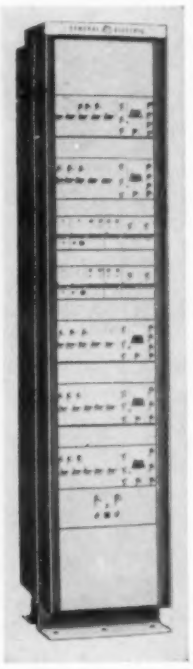
This sampling unit is designed for simple, accurate and convenient method of collecting representative samples of liquid flowing in pipe lines. It can be operated either manually or automatically, regardless of pressure. Manually by turning unit handle ¼ turn; automatically by motor and timing device.

There is nothing to drain, clean or bleed before taking sample. It is taken at line pressure and stored in a container at atmospheric pressure. The ARCCO Instrument Company, Inc., unit takes samples without restricting flow of liquid in line.

For more data, circle **No. E12** on Readers' Service Card, last page this issue.

Radio Relay System

An error reducing transistorized microwave radio relay system that provides a 10-fold increase in transmitting power output but requiring 50 percent less power input has been developed by General Electric Company.



Designed to eliminate transmission errors to achieve a new high in reliability, the unit is designated RF-7 and transmits at frequencies from 5925 to 8400 megacycles. It can be employed for systems requiring up to 600 telephone channels. Each voice channel may be further divided into as many as 20 controls, supervisory or telemetering channels. For remote alarm, an optional control package is available. This can monitor 100 remote stations and automatically ask each 10 questions concerning remote functions. With transistor circuits and modular plug-in construction, equipment size is cut down.

Designed for both DC and AC operation, battery operation is made feasible by lower power input. One of the unit's features is a heterodyne repeater option which facilitates transmission over longer distances with more channels of information and lower circuit noise.

For more data, circle **No. E13** on Readers' Service Card, last page this issue.

Fill Valve

An automatic fill valve for force feed lubricators is announced by McCord Corporation. It keeps all oil reservoirs filled automatically. It thus keeps lubricator from running dry and extends time period for checking oil supply on force feed lubricator.

Made of steel with ball check valve that lifts from its seat by action of unicellular foam rubber float.

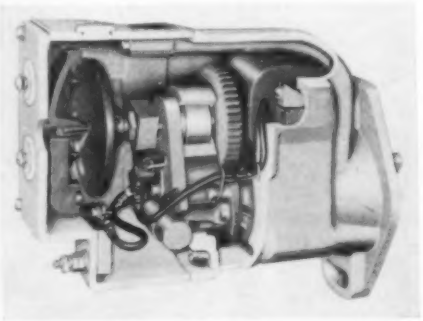
(This item supplements McCord Corporation data on page 271 of the Pipe Line Catalog, Third Revision.)

For more data, circle **No. E14** on Readers' Service Card, last page this issue.

Skid Mounted Stations

Skid-mounted town border stations are available from R. E. Reutzel Company, Fremont, Neb. These units are designed with a width of less than eight feet to prevent overwidth transporting problems. Stations are being made for delivery to Northern Natural Gas Company in South Dakota and Minnesota.

For more data, circle **No. E15** on Readers' Service Card, last page this issue.



Ignition System

A new low-tension ignition system for gas and gasoline engines is intended for use on large industrial engines where continuous duty is of prime importance. Only current inside the magneto is a low voltage, designed to provide longer life of the unit and its component parts.

The Fairbanks, Morse & Co., system includes transformers of either the standard or shielded type. Transformers, one for each cylinder, are mounted on the engine block.

For more data, circle **No. E16** on Readers' Service Card, last page this issue.

One of Pentzien's 24-inch wide Swing Sling lowering-in belts is shown lifting a 24-inch O.D. concrete-coated pipe. This operation was at Renovo, Pa., where Pentzien laid a main and auxiliary line under the Susquehanna River for the Texas Eastern Transmission Corporation.

For Pentzien, Inc.,
The **Swing Sling*** *is a real money saver*

"We use CF&I-Wickwire's Swing Sling as a lowering-in belt on pipe-laying operations because it saves us money on pipe repairs and sling replacements," says Forrest H. Andrews, Field Superintendent of Pentzien, Inc., Omaha.

Swing Slings are covered with neoprene blocks that provide equal distribution of weight and prevent the belt edges from cutting into the surface of coated pipe. Mr. Andrews says, "When we used other belts, we continually had to make repairs to damaged surfaces that cost up to $75 in labor and lost production each time. The Swing Sling has eliminated all that."

The neoprene blocks protect the rugged steel cable itself from the abrasive action of concrete-covered pipe. As a result, Mr. Andrews expects the Swing Sling to give him at least twice the service of any belt previously used. He also claims that his Swing Sling's 24-inch surface is wide enough to make the pipe self-centering during lowering-in, thus facilitating lining-up and welding operations.

The Swing Sling is available in five "pipeline" models — widths 12", 18", 24", 30" and 36"—and any length over 4'. For complete details, contact your CF&I-Wickwire sales office or distributor.

*trademark—Patent Pending

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For more data on advertised products, use Readers' Service Cards, last page.

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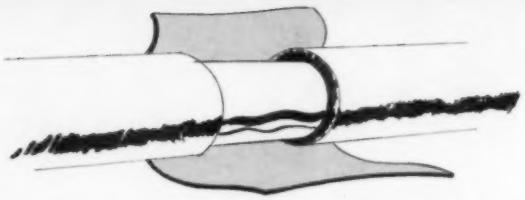

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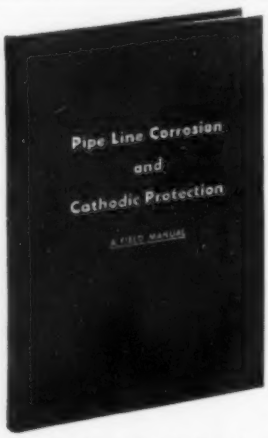

The most practical on-the-job manual for men concerned with pipe line corrosion.

Pipe Line Corrosion and Cathodic Protection

By MARSHALL E. PARKER

This book is designed as a practical field manual. It provides workable methods that can save you valuable time and effort in obtaining interpretive field data.

Contents (Condensed). Soil Resistivity Surveys, Pipe-to-Soil Potentials, Line Currents, Current Requirement Surveys, Rectifier System for Coated Lines, Ground Bed Design and Installation, Magnesium Anodes on Coated Lines, Hot Spot Detection, Stray Current Electrolysis, Interference in Cathodic Protection, Operation and Maintenance, Coating Inspection and Testing.

Appendices cover: Fundamentals of Underground Corrosion, Basic Principles of Cathodic Protection. Plus . . . tables and properties of metals, attenuation equations and index.

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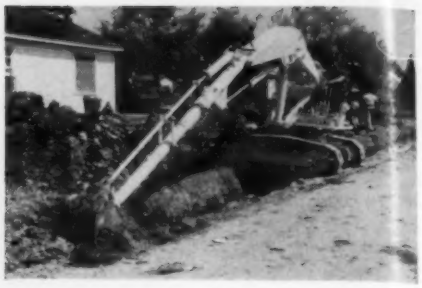
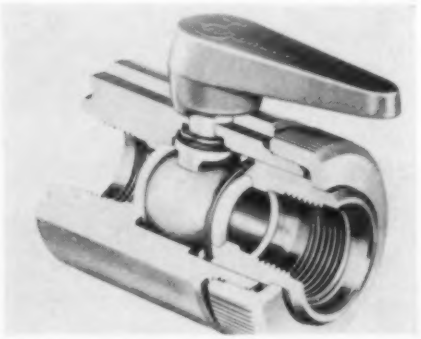


Backhoe

Hydraulic Equipment and Shovel Company announces its all-hydraulic hoe-loader-shovel. Manufactured in crawler and self-propelled models with a wide range of attachments, the unit has a high-torque hydraulic motor swing arrangement and 50-ton enclosed double row ball bearing turntable. The motor drives each track independently. Crawler features sealed lifetime tapered bearings in track rollers.

For more data, circle **No. E17** on Readers' Service Card, last page this issue.



PVC Ball Valve

Extending its line of PVC valves, Walworth Company has introduced a new ball valve. The low-torque valve requires only a quarter-turn to operate. It is manufactured in sizes through 4-inch. Available in socket weld or threaded ends, the valve features a rugged, compact body with external one-end adjustment.

(This item supplements Walworth Company data on pages 497-504 of the Pipe Line Catalog, Third Revision.)

For more data, circle **No. E18** on Readers' Service Card, last page this issue.

Rubber-Tired Crane

A rubber-tired, 25-ton Lorain Moto-Crane has been introduced by The Thew Shovel Company. This Model MC-325 is

the latest addition to the Lorain line of rubber-tired cranes that range from 7 to 80-ton lifting capacity.

The unit features "full circle" visibility cab, a "flit-top" roof design providing walk around accessibility and "power-set" outriggers that can be set from travel to working position in about a minute. Two tandem driven rear axles with high traction differentials mounted on equalizer beams provide 15 speeds forward up to 47 mph.

For more data, circle **No. E19** on Readers' Service Card, last page this issue.

Gas Sweetening

A line of gas sweetening vessels for use where concentration of H_2S is below 50 grains per 100 cubic feet has been introduced by Southwest Equipment Company. The unit uses iron oxide method of passing gas through a bed of iron sponge. No pumps, towers, heaters, source of power or water are required, reducing maintenance to a minimum.

This type vessel also is used to clean up gas that still retains some mercaptans after passing through amine plants. The unit are fairly portable, can be installed in one day and have no moving parts. They are available in capacities from 300 Mcf to 25 MMcf and pressures up to 1,000 pounds.

For more data, circle **No. E20** on Readers' Service Card, last page this issue.

Flow Chart Counter

For use with orifice flow chart integrators, a new counter has been developed to eliminate errors in subtraction and permit time savings up to 20 percent.

The flow measurement Reset-Duad Counter has two separate counters (A and B) and performs two operations. It totalizes each individual chart—resetting to zero after each is completed, and it accumulates the individual and chart extensions for batch totals. After each chart is placed on the integrator, the operator depresses the time bar trigger arm. This automatically runs the reset section back to zero, but does not disturb the totalizing section. The Flow Measurement Company unit is available in two models.

For more data, circle **No. E21** on Readers' Service Card, last page this issue.

Hydraulic Accumulator

A new oil-hydraulic accumulator with three functions has been introduced by Crescent Hydraulic Company. It can be used as a power storage chamber so a low volume pump can supply a large amount of energy for a brief moment; a pressure compensater to maintain system

NORTHERN RADIO COMPANY
INCORPORATED
NEW YORK, N.Y.
PRINTER RELAY
TYPE 237
MODEL
SER
NEW
TRANSISTORIZED
PRINTER RELAY
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- ☐ COMPRESSED AIR FOLDER
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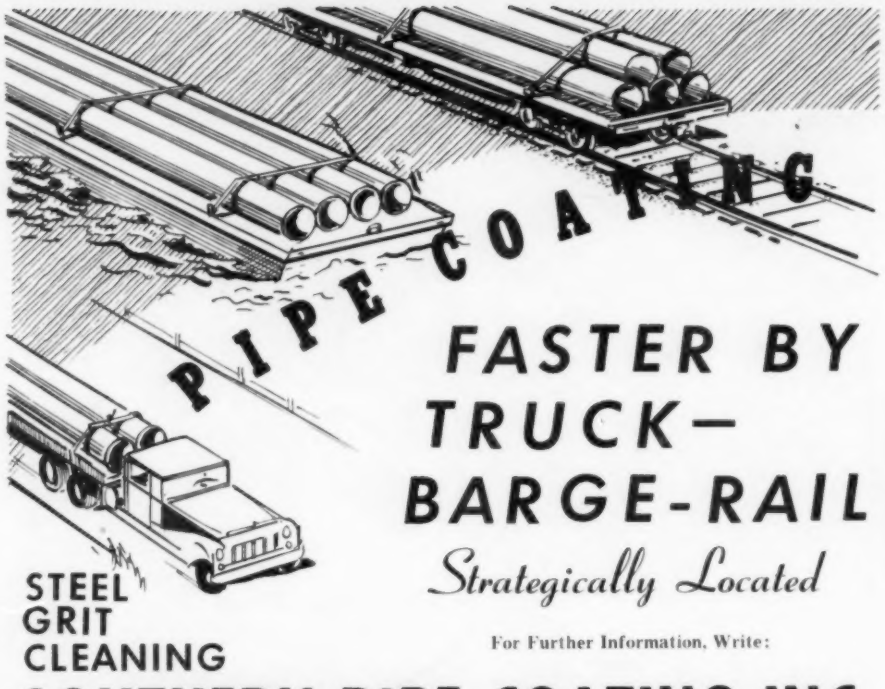

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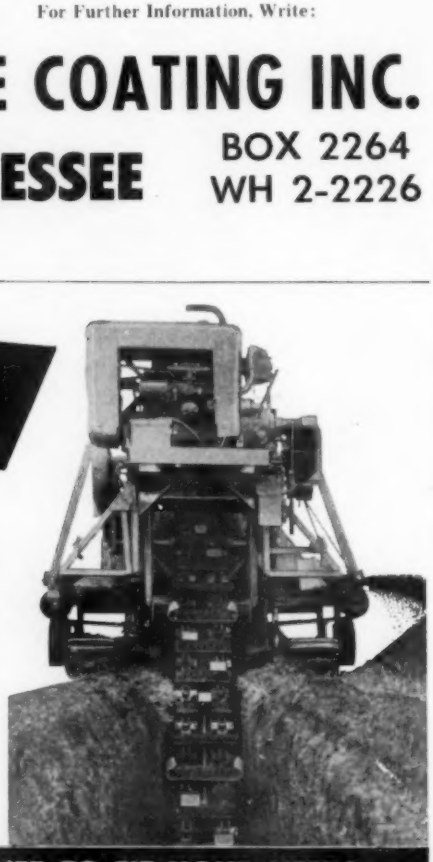

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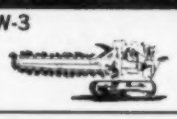
4T W-3  W-1 3P

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pressure so holding cylinders do not lose their grip, and to eliminate surges and vibration, smooth out pressure pulses and prevent shock from fast-closing valves.

Weldless steel outer shell is made in one piece by spin-forging. Hollow aluminum piston is statically balanced, includes double Quad-Ring seals. It is proportioned to displace a maximum amount of fluid with a minimum gas charge and no danger of pressure lock.

For more data, circle **No. E22** on Readers' Service Card, last page this issue.

Split-Sleeve

A split-sleeve in extra-long size, originally developed for a major oil company is now available from Pipe Line Development Company, Cleveland, Ohio. This larger Smith Split-Sleeve, 24 inches in diameter by 54 inches long, is designed for 950 psi maximum working pressure.

The body of this sleeve is made of 1½-inch thick firebox quality ASTM A-285 certified steel plate, grade C. Side bars are C-1020 hot rolled steel. Bolts are ⅓-inch diameter B-7 alloy steel. Nuts are C-1018 cold rolled steel, especially made with chamfered bottoms to facilitate seal-welding. The ends are turned down for fillet-welding to pipe. Side bar spaces and bolts may be completely seal-welded and welding may proceed with pipeline in service.

(This item supplements Pipe Line Development Co. data on page 320 of the Pipe Line Catalog, Third Revision.)

For more data, circle **No. E23** on Readers' Service Card, last page this issue.

Line Operated Valve

A valve that may be operated by line pressure alone, or by pneumatic, hydraulic and electric systems, has been developed by KeXplore, Inc.

The full-flow, non-lubricated valve will handle fluids, slurries and gases. It is designed to be remotely controlled inherently.

For more data, circle **No. E24** on Readers' Service Card, last page this issue.

One-Man Tamper

A light-weight ram-type addition to the line of one-man tampers has been introduced by Jay Company, Division of J. Leukart Machine Company, Inc. Powered by a four-cycle gasoline engine, the unit is designed to compact clay soil and hold up under continuous use.

For more data, circle **No. E25** on Readers' Service Card, last page this issue.

New Equipment Literature

For more data on New Equipment or copies of Catalogs and Literature reviewed in this issue, use the Reader Service postcards just inside the back cover and facing the Advertisers' Index. Simply circle code numbers of items desired—sign and mail card.

Pipe Line Controls

A four-page brochure describing unit loading valve sequence equipment and a six-page brochure describing packaged sequence control equipment for angle engine compressors have been issued by Union Switch & Signal, Division of Westinghouse Air Brake Company.

The brochures present detailed information and illustrations on this control equipment.

To get a copy, cirle **No. E26** on Readers' Service Card, last page this issue.

Bitumastic Coatings

The complete family of bitumastic primers and enamels is described in an illustrated bulletin released from Tar Products Division of Koppers Company, Inc. The bulletin includes a color-coded enamel selector. Divided into three sections, the first concerns facts behind protective properties of the coal-tar base enamels. Bitumastic primers and enamels are discussed in the remaining sections, with special emphasis on the new, quick-drying jet-set primer.

To get a copy, circle **No. E27** on Readers' Service Card, last page this issue.

Temperature Controls

An eight-page brochure released by Fenwal Incorporated, brief descriptions and specifications are given for 17 different types of temperature controls.

Included are details on 12 styles of Thermoswitch units, six miniaturized local controls, four fire and overheat detection models, four snap action controls and seven electronic controllers.

To get a copy, circle **No. E28** on Readers' Service Card, last page this issue.

Machine Components

Complete explanation of Caterpillar Tractor Company's parts assembly exchange program is offered in a new booklet "Avoid Delay the Modern Way."

The eight-page booklet also contains stories from owners, mechanics and job superintendents on how the program has helped them.

To get a copy, circle **No. E29** on Readers' Service Card, last page this issue.

Generators

A line of synchronous, AC generators rated 187 kva and larger, is described in a bulletin published by Electric Machinery Mfg. Company.

They feature dripproof construction, direct connected exciter, "thru greased" bearing, roomy terminal boxes and end to end ventilation. Easy access to brushes is another feature. Designed for low stator core loss, the generators are available in all standard voltages, 60 or 50 cycles, single or 3 phase.

To get a copy, circle **No. E30** on Readers' Service Card, last page this issue.

Preheating and Welding

Many preheating and stress relieving problems can be solved with the aid of 400-cycle induction heating booklet, EW-249, published by Hobart Brothers Company.

The 32-page, 16-section booklet answers questions about why, when and what to preheat and stress relieve. Some of the sections include information on demand for stress relieving, when to stress relieve, purpose of stress relieving, types of post heat treatment for welded joints, preheating before welding, etc.

To get a copy, circle **No. E31** on Readers' Service Card, last page this issue.

Welding Products

Information concerning the full line of arc welding products is available in Lincoln Electric Company's bulletin on Weldirectory.

It includes information on AWS electrode classification and discusses correct electrode selection for every type of welding application. Arc characteristics, welding procedures and physical properties are listed for each electrode.

To get a copy, circle**No. E32** on Readers' Service Card, last page this issue.

Hinged Closure

Developments to improve product features and provide greater design uniformity in its line of quick-opening hinged closures are described in a brochure available from Tube Turns Division of Chemetron Corporation.

Illustrations include typical vacuum, low and high-pressure installations in petroleum, gas transmission and other industries and show one-weld installation, easy maintenance, one-man operation and built-in safety features. Charts give dimensional specifications.

To get a copy, circle **No. E33** on Readers' Service Card, last page this issue.

Automation Control

A brochure describing various telemetering, remote control, data processing and data transmitting systems has been issued by Hammarlund Automation Division of Telechrome Manufacturing Corp.

Information on automatic electro-mechanical systems, errorless transmission systems and standardized automation components is included.

To get a copy, circle **No. E34** on Readers' Service Card, last page this issue.

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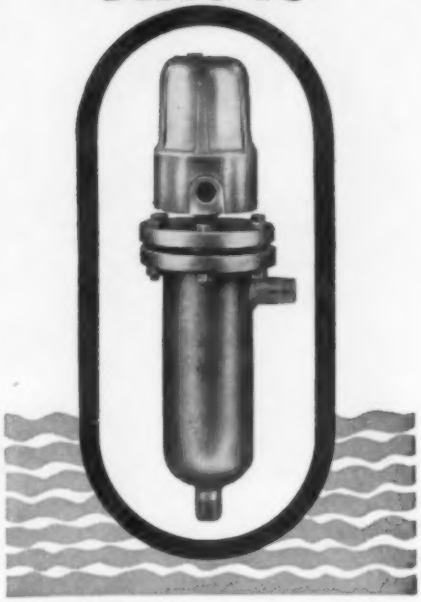

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Company_____

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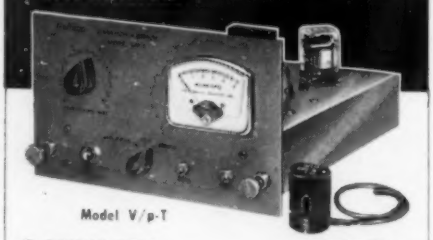
Indication aids detection of developing failure. Automatic higher set-pt. during start-up provides continuous protection. No time delay relay required to override. Responds in ½-sec., yet avoids false shutdowns.



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- Set-pt. covers 0-to-5 mils (or higher)
- 48 volts or 60 volts DC operation.
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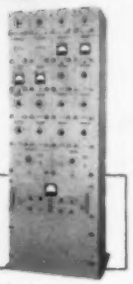

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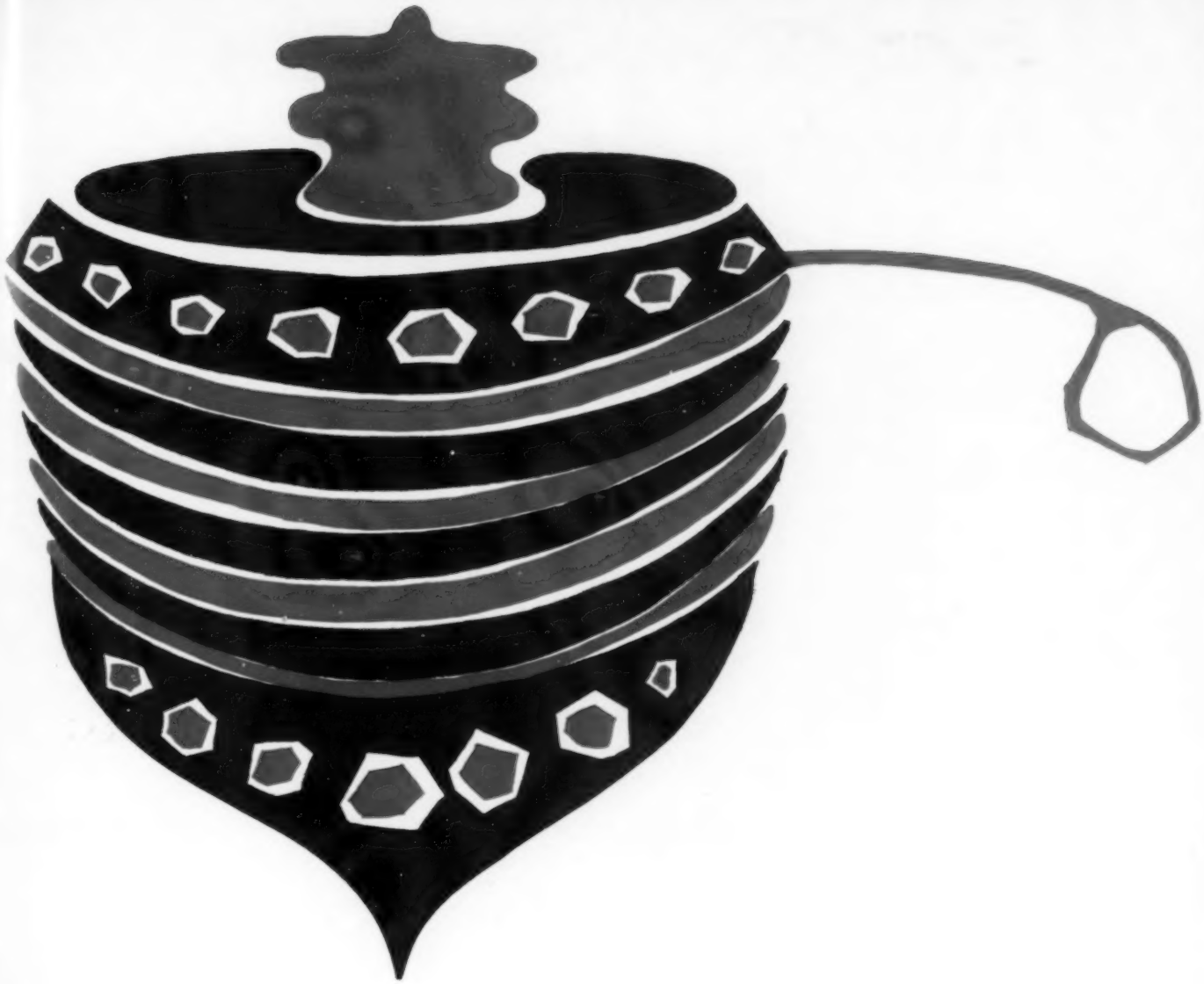

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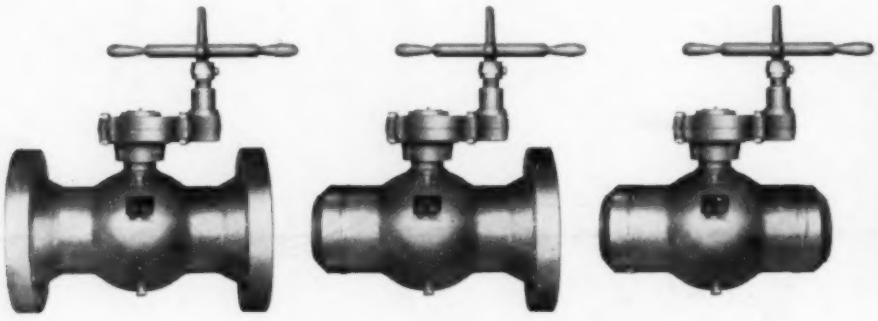

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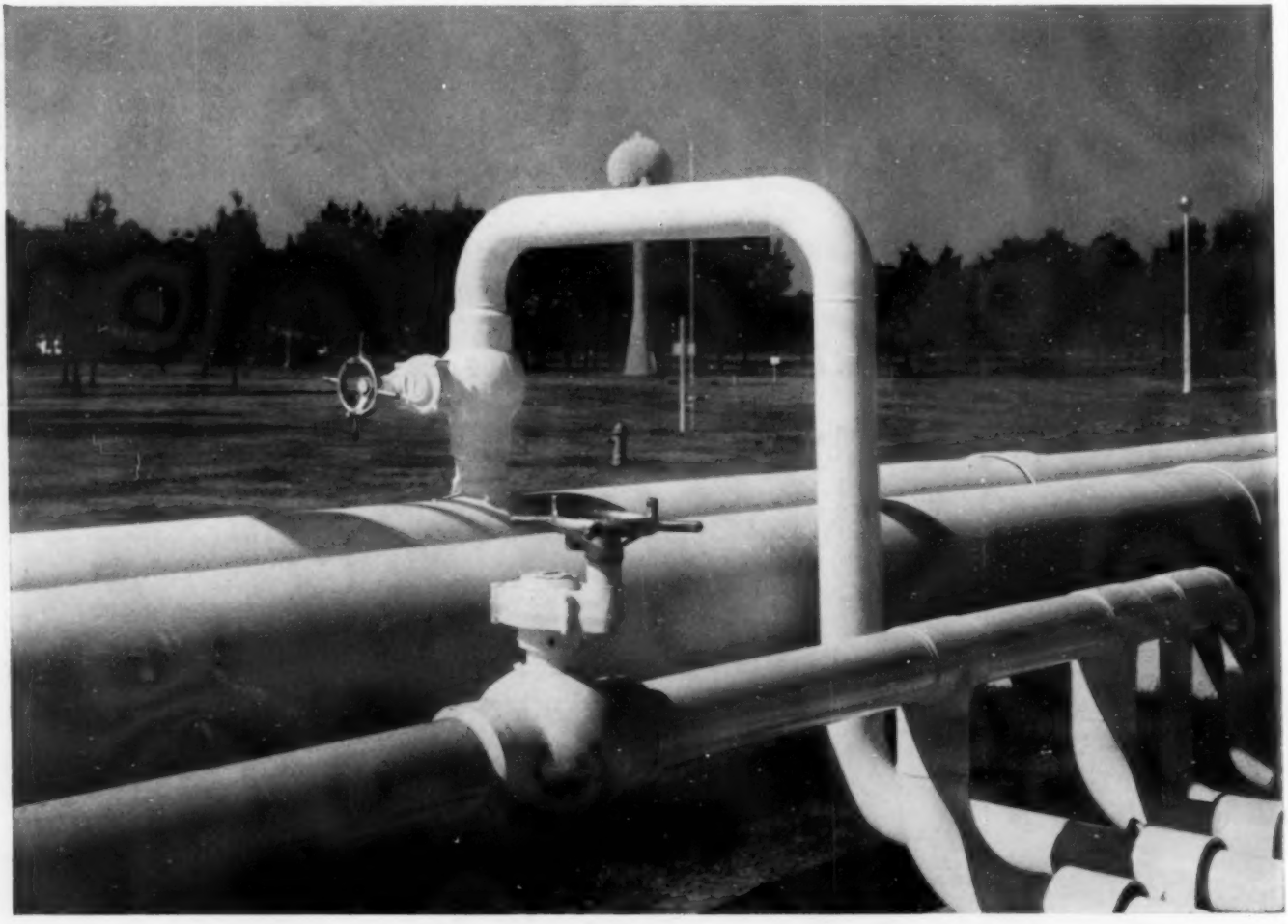
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